The Dock and Harbour Authority

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Editorial Comments

The Isle of Man.

Among the numerous smaller territorial units which make up the geographical group known as the British Isles, the Isle of Man occupies an important place. More detached from the mainland than Anglesey or the Isle of Wight, and yet not so remote as the Channel Islands or the Scottish Archipelagos, it lies in a location which gives it both detachment and proximity. It is enclosed midway in the spacious embayment of the Irish Sea which skirts the coast of Lancashire and Cumberland, and is North of Wales, South of Scotland and East of Ireland. As regards size, it is not particularly remarkable, being about 33 miles long and about 12 miles wide in the broadest part, but its superfices of 225 square miles comprises some of the most beautiful scenery of a very varied character, and it is perhaps the chief popular holiday resort of the whole of the North of England. It is visited by half a million people annually.

Detachment in location has produced a corresponding independence in character, government and tradition. There is a separate legislature, called the Tynwald, consisting of two branches, the Governor and Council, and the House of Keys, the latter an elective chamber, one of the most ancient legislative assemblies in the world. An interesting feature is that Parliamentary enactments become law by public promulgation on Tynwald Day (July 5th) from Tynwald Hill.

The political history of the Island goes back to days before the Norman Conquest. Norway held rule in it for three centuries from the year 870, when it fell into the hands of King Harold. Then, in 1263, Alexander III of Scotland defeated Haco at the battle of Largs and, together with other northern islands, Man passed into Scottish hands. At the end of the 14th century, Henry IV of England seized it, and at this point an interesting development took place. The Island was bestowed upon the Stanley family, who held it under the style of Kings of Man till the middle of the 17th century, when the title of Lord was substituted. Readers of "Peveril of the Peak" will recall how the fugitive Margaret de la Tremoille, widow of the ill-fated Earl of Derby, is addressed by Lady Peveril as one possessing regal rights and dignity. It is questionable whether in 1660 or thereabouts this is not a slight anachronism, but in any case, the sovereignty was ultimately acquired by the English Crown, being purchased in 1827 for the sum of £417,144.

We have rather wandered from the prosaic facts appropriate to the purview of Dock and Harbour administration, but as these in their local aspect, are so fully set out in the article by Mr. Brown which accompanies the illustrated supplement this month, we may perhaps be excused a slight digression on particulars of so interesting a character.

The Island is rich in minerals—lead, iron, zinc, copper, etc., and about 2,000 tons of lead are extracted from mines annually. Trade is mainly in foodstuffs. There is a liability to occasional heavy gales from the South-west, but otherwise the conditions are agreeable, and readers of Mr. Brown's article will see how much has been done by the Harbour Commission to facilitate the reception of visitors in comfort and safety.

South Wales Dry Docks.

The value of the Dry Dock accommodation at the South Wales ports in time of war and its capacity to meet possible demands upon it, has been the subject of considerable discussion since the development of the international political situation. Indeed, the matter is one of great public importance, and it is not surprising that it has caused some amount of anxiety. A few months ago, a committee was appointed at a meeting of representatives of the ports in the South Wales area, including Cardiff, Newport, Barry, Port Talbot and Swansea, to investigate the position. This committee has just completed its task and presented a memorandum which is to be submitted to the Government for consideration.

In the event of an outbreak of hostilities, there is the obvious probability of the diversion of a considerable amount of shipping from ports on the eastern and south-eastern coasts to those on the western seaboard, and the question arises whether as the result of an intensive submarine campaign, the pressure on the existing dry-dock accommodation might not become extremely acute and the facilities prove inadequate to cope with requirements. No doubt, for present needs, they are sufficient and, perhaps, ample, but this is no guarantee of adequacy in a national emergency.

Linked up with the general question is the proposal to recondition the Pembroke Dock for naval purposes. This, while it would have some bearing on the repair of war vessels, would hardly assist the Mercantile Marine. Indeed, it is authoritively stated that Pembroke Dock is not suitable for the repair of ships of modern construction, and that the base had formerly only been used for the repair of small ships.

The whole matter is one which demands urgent attention, and it is to be hoped that the representations of the South Wales Port Authorities will receive full consideration.

Port of London Stevedoring.

A rather serious charge, reflecting on the cargo-handling methods of the Port of London, was made by Mr. Robert Kelso, chairman at the recent annual meeting of the General Steam Navigation Company. In the course of his address to the shareholders, he said that the high cost of stevedoring in London caused the directors of the Company grave concern. He alleged that the cost was not only very appreciably greater than at the outports, but that it had actually risen from 50% to 60% greater. He complained that port workers gave no evidence of a wish to co-operate with their employers to keep down the costs, despite the fact that the keen competition of other carriers, especially road and rail, in traffic coastwise should make it clear to dock labour that closer co-operation in the general interests of both employers and men was most essential.

The accusation has been made more than once that London is a "dear" port, but this has been attributable to the higher scale of port rates and dues and not to cost of labour. The explanation given is that on account of the large amounts of capital expended on an extensive system of enclosed docks, the overhead charges are necessarily greater than at certain nearby Continental ports where, under more favourable physical conditions, no such outlay has had to be incurred. If, however, in addition to this unavoidable handicap, there are unduly high impositions of labour charges for cargo handling, the difficulties of successful competition are greatly increased.

A Forth-Clyde Canal.

Ship canals, either in the making or in the enlargement, continue to attract public attention. The latest proposal, if it can be termed such, in view of the fact that the matter has been mooted on a number of occasions in the past, is that of a canal to link the Firths of Forth and Clyde. Actually, there is already a barge canal in existence on the site, constructed as far back as 1790. It is 35 miles long, with a depth of 10-ft., but, as the

Editorial Comments - continued

track has to surmount a height of 158-ft. above sea level, necessitating the use of 39 locks, it is not judged altogether the most suitable route for the passage of shipping.

The revival of the project for a ship canal arises from the desirability of establishing a convenient connection between the East and West coasts of Scotland in case of naval eventualities. The example set by Germany in enlarging the Kiel Canal, to facilitate the passage of warships from the Baltic to the North Sea, has aroused a feeling for corresponding preparedness in English naval circles, and the desirability of establishing more than one approach to the Rosyth base and dockyard has impressed itself with a certain definiteness.

The Forth Bridge, which sits astride of the Firth of Forth, may unwittingly serve as a portcullis to cut off access to Rosyth from the East. The danger of a bombing attack on the bridge, which might result in the blocking of the underlying fairway, is not so remote that it can safely be ignored. It would no doubt be a lucky shot which demolished the structure, but such hundred to one chances have come off before now, and the effects in the present case would be very serious.

There are a variety of routes from which to select, but that which appears to have gained most favour is one considerably to the north of the existing barge canal, passing through fairly level country, and not requiring other than terminal locks. Such a route would have a length of about 30 miles from the River Forth at Grangemouth to the Eastern end of Loch Lomond. Exit from the Loch would be at Balloch, a distance of 5½ miles, with a deep-water channel throughout, to a cutting five miles in length connecting with the River Clyde at Dumbarton. This would make the total length of canal 35 miles, which is by no means excessive when compared with the 61 miles of the Kiel Canal and the 50 miles of the Panama Canal.

The spacious area of Loch Lomond would be available for sheltered harbourage, an advantage for commercial shipping, which would also derive economic benefit from the shortening of the route. From London to Glasgow there would be a saving of 370 miles; from Leith to Glasgow a saving of 615 miles; transatlantic passages to Baltic ports would realise a saving of something like 500 miles.

No figures have been published as to the estimated cost, and until these are supplied for consideration, it is not possible to give an unqualified endorsement of the proposal, which, however, has many features to commend it for approval.

The Albanian Harbours.

The invasion by Italy of the neighbouring country of Albania has drawn attention to the harbours of the latter into which the Italian warships penetrated with troops and war material. Generally speaking, the coastal frontage consists of a marginal lowland interspersed with perennial streams of torrential force, different altogether in character from the abrupt ruggedness of outline of the seaboard to the north and south. The shore waters are always more or less in a state of turbidity, owing to the silt carried down by the rivers. In spite of this, however, there are several good natural harbours: San Giovanni de Medua, Durazzo and Valona among others, where safe and satisfactory anchorage is to be found, though the ports to which they belong are not, as yet, developed to any extent. Sea-borne trade, too, is poor, though it has improved of recent years. Imports consist chiefly of textiles, cereals and metals; exports are largely animals and animal foods, raw hides and wood.

No doubt the Italians count on exploiting very extensively the internal resources of the country. There are vast forests of oak, walnut, chestnut, etc., in the lowlands, as well as of conifers in the higher regions. The vine is grown over a fairly large area, and rice and tobacco are produced. The mineral wealth of Albania, merely conjectured at present, remains to be ascertained. Asphalte, bitumen and petroleum are known to be present, and there are coal seams in several regions.

Speaking generally, the country is in quite a backward condition, with primitive practices and habits of life. By means of the expenditure of capital (only obtainable from foreign sources) its remunerative development is quite possible, and there would then be scope for the construction of appropriate port and harbour works.

American Free Port Areas.

For some time past the subject of Foreign Trade Zones, or, as they are termed in Europe, Free Port Areas, has been engaging the attention of port officials on the further side of the Atlantic, and there has been recorded in these columns the installation of two such zones at the ports of New York (Staten Island) and of Mobile, Alabama. A third zone was advocated at the Port of San Francisco, but this project has not yet matured. The matter is still under discussion and will, in all probability, eventually be carried into effect.

In the proceedings of the 25th Annual Convention of the Pacific Coast Association of Port Authorities held in Portland, Oregon, last August, a copy of which has recently been received at the office of this Journal, two papers were presented dealing with the subject, one by Mr. Thos. E. Lyons, Executive Secretary of the Foreign Trade Zones Board, of the Department of Commerce, Washington, and the other by Mr. Mark H. Gates, Secretary of the Board of State Harbour Commissioners, San Francisco.

Without traversing again the arguments for and against the establishment of free port areas, which have already been sufficiently ventilated in these columns, notably in the exhaustive report of Mr. H. Fugl-Meyer on the proposal for a foreign trade zone at the Port of Boston, it is interesting to note two rather unusual points put forward by Mr. Lyons in favour of the free-port principle. He instanced the case of the importation of a consignment of alleged cod liver oil, a commodity which is admitted duty free into the United States, but is liable to a severe penalty if the product is not what it is claimed to be or does not come up to U.S.P. standards. The importer of the oil took the precaution of securing an official inspection in the zone prior to Customs entry, and found the oil to be that of another fish, and so was " in the position of being able to return the oil without loss or to enter it under the proper name without penalty."

In the second case, importers of several thousand tons of Brazil nuts allowed them to ripen in the zone. The drying of the nuts resulted in the saving of a considerable sum in duty ($3.36 per ton) on the weight owing to the evaporation of moisture before passing them through the Customs.

It may, of course, be contended that both these advantages could have been obtained under cover of a Bonded Warehouse, and opinion in this country is apparently more in favour of bonded warehouses than of free-port areas, despite the restrictions imposed on access and the troublesome formalities of Customs' routine. On the Continent of Europe, free-port areas are much more in evidence, notably at Hamburg, Copenhagen, Dantzig and Gdynia. The allocation of an isolated area for the reception of dutiable goods, pending re-export or payment of duty, is, however, not without its difficulties and drawbacks. Not to be lost sight of is the consideration whether such an area will attract new business to the port, or simply serve to divert existing trade.

Studies of Wave Action.

Arising out of certain catastrophic experiences at Algiers, Catania, Antofagasta and elsewhere, a considerable amount of attention has been given of late years to the phenomenon of wave impact on breakwater structures in exposed situations. The subject was under discussion at the Cairo International Navigation Congress in 1926, and since then, a series of close experimental investigations, by means of scale models in tanks, has thrown an appreciable amount of light on a problem which is beset with various conflicting factors. It is opportune that the accumulation of facts and data should have been summarised in a recent article by Messieurs de Rouville, Besson and Pétry, with the collaboration of Messieurs Beau and Baudelaire, in a recent article in the Annales des Ponts et Chaussées, and we are glad to have been permitted to present in this issue a statement of the results achieved. A good deal of work remains to be done before the matter can be said to be completely probed, but the situation at present is much clearer than it was in the earlier stages of breakwater design, when engineers had to base their calculations on imperfect and unreliable assumptions.

The Quarterly Shipbuilding Returns.

The returns of the shipbuilding industry in this country continue to be unsatisfactory, and they give no sign of immediate recovery from the depression which has characterised the industry for some time past. The statistics issued by Lloyd's Register of Shipping regarding merchant vessels under construction at the end of March last show that in Great Britain and Ireland there is a decrease of 182,859 tons in the work in hand, as compared with the figures for the previous quarter. The present total of tonnage under construction, 596,903 tons, is less by 492,174 tons than the tonnage which was being built at the end of March, 1938.

On the other hand, the tonnage now under construction abroad—2,106,764 tons—is 217,662 tons more than the work which was in hand at the end of December last. The contemplation of this disparity is certainly not conducive to a feeling of complacency in those who are concerned for the welfare of the British Mercantile Marine.

Happily, this is not the picture in its entirety. The recent announcement of the Government's intentions to provide financial assistance to the industry has resulted in a substantial increase in orders for new tonnage, and owners have shown a satisfying readiness to avail themselves of the promised subsidies outlined in the Board of Trade Statement which appeared in the press early in April. It is pointed out that several yards which were without work have been re-opened in order to deal with contracts now being received. It is confidently to be hoped that the next Quarterly Return will make a much more favourable showing.

The Harbours of the Isle of Man

By J. C. BROWN,
Engineer to the Isle of Man Harbour Commissioners.

THE harbours of the Isle of Man are eight in number and, in the order of their trade importance, are as follows:—Douglas Harbour; Ramsey Harbour; Peel Harbour; Castletown Harbour; Port St. Mary Harbour; Laxey Harbour; Port Erin Harbour; Derbyhaven Harbour.

The harbours are the property of the Crown, and the various and several Acts under which they are administered are Acts of the Imperial Parliament. Their control is vested, by Statute, in the Isle of Man Harbour Commissioners, which consists of a body of five members of the Insular Legislature. Four Commissioners are nominated, from time to time, by His Excellency the Lieutenant Governor of the Island and approved by Tynwald (the Manx Parliament) and act under the chairmanship of His Majesty's Receiver General, who is also a member of the Legislative Council or Upper House. These Commissioners have enlisted in their service their own administrative staff, technical staff and police, and they are responsible for the control of the harbours generally.

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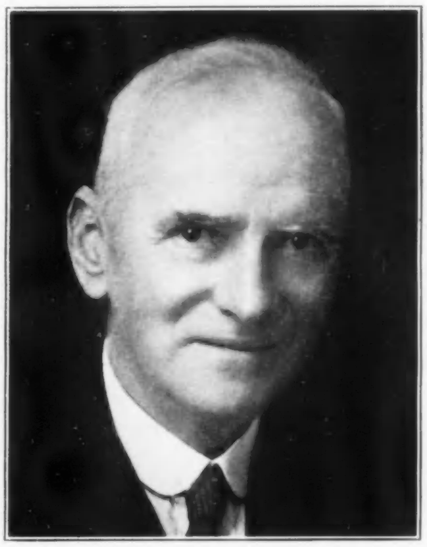


H.M. Receiver General,
R. C. CAIN, Esq., M.L.C., J.P.,
Chairman of I.O.M. Harbour Commissioners

Mr. H. T. MATTHEWS,
Secretary

The revenue from the harbours, which is derived from Passenger Tax, Harbour Dues, Licences, Rents and various Tolls, is paid over to the credit of the Manx Government, and all monies required for general Maintenance and Additional Works, are included in the Lieutenant Governor's Annual Budget.

The foundation and early development of the harbours was—for the most part—consequent upon the birth and expansion of the Insular industries of Fishing, Mining and Agriculture; but in latter years these industries have passed through many vicissitudes, and have now become entirely eclipsed by the magnitude of the present Passenger Traffic or "Visiting Industry." Approximately 99% of the passenger traffic involved passes through Douglas Harbour, and whereas a considerable annual sum of money is expended on the efficient maintenance and necessary development of each of the other harbours, Douglas Harbour has been developed to the full—within practical limits—to cope with the demands of this large and representative traffic.

DOUGLAS HARBOUR

Historical

Prior to the year 1700, the harbour at Douglas consisted of little more than the channel of the river, having upon its northern bank a scattered hamlet which formed the nucleus of the future town. In the year 1720, however, the first harbour works of a permanent nature existed in the masonry pier, known as the "Tongue." Northward and southward of this pier, limestone-faced quay walls, founded along the northern bank upon pitch pine timber rafts sunk into the river mud, and along the southern bank upon rock, were commenced at this period. The works were financed by public subscription, and were sufficiently well constructed as to exist, in part, to the present day. This early harbour formation at the beginning of the 18th century, formed the root of the present harbour; but, apart from intermittent work upon the quay walls, no attempt was made to extend the harbour seaward beyond the point of the Tongue until the year 1765, when the Insular Harbours were conveyed to the Crown by the Duke of Athol. In this year and during the following 20 or 30 years, development alone took place in extending the quay walls seaward in a search for deeper water; but about the year 1790, development of this nature had reached its natural limits without satisfying the increasing demands of shipping, and that stage in the harbour's history had arrived, when further extension had of necessity to take the form of outlying piers. The trade of the port at this time demanded further accommodation, and the "visiting industry" was showing possibilities, but in the economic interests of a small island community, the construction of harbour works in the sea had to be pursued with a cautious policy.

The Red Pier

The British Treasury, therefore, in 1790, sent a skilled Engineer to Douglas to report generally on the state of the harbour. His report stressed the need for a sheltering breakwater, but of his various proposals one only materialised, in the construction of the Red Pier, which was completed at a cost of £25,000 in 1801.

The construction of the Red Pier constituted the first serious attempt to extend the harbour seaward. The quay walls had in previous years been extended seaward to some extent, but being backed by Mother Earth, they appealed to the imagination of the people far less than the new pier which was thrust out into the sea; the Red Pier, therefore, not only added 500-ft. of deeper wharfage to the harbour and afforded additional shelter for the inner harbour, but became the fashionable promenade and cherished possession of the inhabitants of Douglas, who contributed the bulk of the cost for its construction.

In 1826, Sir William Hilary, a native of the Island and founder of the National Lifeboat Institution, placed before the Admiralty a scheme for a breakwater "extending boldy across the bay, to form a stupendous harbour of refuge worthy of the British nation." Following this proposal, many of the Liverpool shipowners put forward complaints to the British Government about the number of wrecks that had taken place in the vicinity of Douglas Harbour, and as a result, the Admiralty sent a Commissioner to Douglas to report on the conditions which prevailed. He submitted a scheme for the construction of a breakwater, extending from Douglas Head in a north-easterly direction, to overlap another arm extending from Conister Rock eastwards; but his report did not fructify, mainly on account of the great amount of money involved.

Fort Anne Jetty

No further propositions for the improvement and extension of the harbour were put forward until the year 1835, when the Lieutenant Governor of the Isle of Man instructed Sir John

Harbours of the Isle of Man—continued

Rennie, F.R.S., to "thoroughly go into the conditions which existed at Douglas Harbour," with a view to forming a "low-water asylum harbour." His report was full and exhaustive, and concluded in recommending protective outer works estimated to cost £216,000. The only portion of the various proposals which materialised was the Fort Anne Jetty, which was erected in the year 1836.

For the following period of 30 years, the provision of the Fort Anne Jetty, together with the existing works at that time, barely satisfied the requirements of the trade, but no further works were embarked upon, although the revolution which was taking place in the nature of shipping, did not pass without concerned observation, and the subject of further protection and enlargement of the port was constantly before the authorities.

In the year 1858, a Royal Commission on Harbours of Refuge was appointed in consequence of the great and serious losses sustained by wrecks of British ships, and largely as the result of strong representations of Liverpool merchants, the Commission visited the Island and held a lengthy public enquiry. The findings of this Commission were, that "Douglas Harbour could be made a safe harbour of refuge with great advantage to ships engaged in coastwise and cross-channel traffic," and recommended a sound and adequate scheme, but the recommendations were not acted upon.

Peel Harbour, showing Fishing Fleet in Outer Harbour [Isle of Man Times Copyright

The First Breakwater

Following the failure of the proposals of the Royal Commission, and after almost continuous agitation by local traders and traders in Liverpool, the Manx Legislature decided that protective works were vital to the well being of Douglas and to the passenger traffic, which was showing enormous possibilities, and in the year 1864 a breakwater, 600-ft. long, designed on the Abernethy principle, was built from the "Little Head" in a northerly direction. This structure had barely been completed when a severe south-easterly storm in January, 1865, demolished a large portion of its length; the remaining portion withstood the ravages of the sea until 1867, when another gale from the same point of the compass completely demolished it.

The Victoria and Battery Piers.

The brief shelter afforded to the harbour during the life of the breakwater, made the necessity of a new structure even more pronounced; but at this time, too, the alarming increase in the passenger traffic, and consequent increase in the number and size of ships using the port, made the provision of deep-water berthage imperative. Prior to 1871, all the passengers were embarked and disembarked at the Red Pier, at periods of high water, but at low water shipping had to "stand off" while the passengers were conveyed to or from in "small boats." The traffic in 1860 had far outgrown this antique method of handling, and consequently in the year 1867, the construction of the Victoria Pier was commenced.

This was the first venture into the "deep" with a masonry pier, and was also the first harbour development at Douglas employing in its construction the use of Portland cement. It proved to be the most valuable and remunerative development of the harbour. By virtue of its exposed position, however, its value to the community was nullified in stormy weather from points North-East, through East, to South-East, and it is not surprising to find it recorded that before the Victoria Pier was officially opened, the advice of Sir John Coode was sought as to the most satisfactory means of protecting this pier and the harbour generally. From Sir John Coode's proposals, the construction of the present Battery Pier was commenced, and finally completed to its present form in the year 1879, at a cost of £110,000.

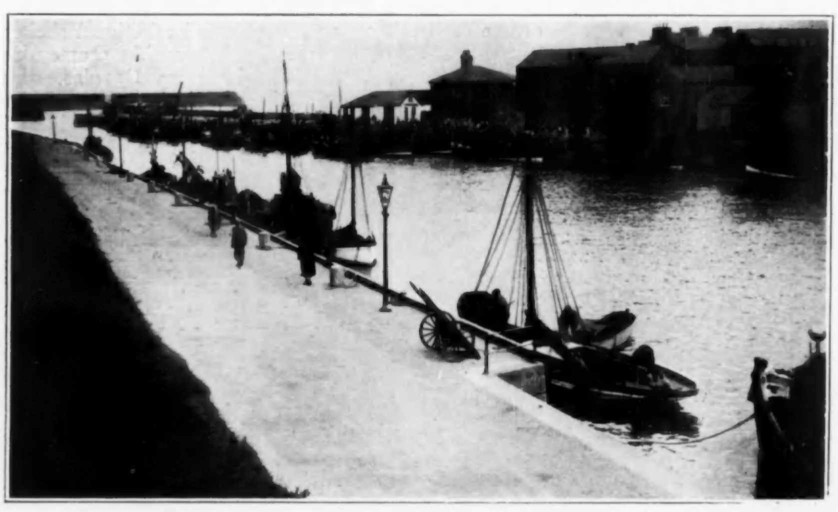
The oscillating demand between "shelter" and "accommodation" again appeared in the year 1887. The passenger traffic persisted in its progressive development, and further low-water accommodation for shipping became imperative, resulting in a decision, in the year 1887, to commence work upon the lengthening of the Victoria Pier by 400-ft., followed by the widening of the approach to the original portion of the pier. This development was completed in 1891, adding two deep-water berths, capable of accommodating the largest passenger vessels using the port, and relieved to a great extent the congestion of traffic which had hitherto taken place at the root of the Victoria Pier.

Upon the completion of the Victoria Pier Extension, innumerable minor developments were carried out to meet the persistent increase in the passenger trade, but no other work of a capital nature was undertaken until 1930, when the Red Pier Extension Scheme was commenced. This scheme—estimated to cost £262,000—involved extensive deepening of the harbour, the construction of a masonry pier, the construction of a leading-in-jetty, and the construction of a viaduct between the new pier and the root of the Victoria Pier. The work was completed in May, 1936, and officially opened by the Rt. Hon. Sir John Simon, and named King Edward VIII Pier. With the exception of the dredging, the whole of the work was carried out departmentally.

The Present Harbour

The harbour may be sub-divided into the "Inner Harbour" and "Outer Harbour." The former is "tidal" and, with the exception of the river channel, dries at low water of spring tides. There is, however, a big range of tide, 21-ft. on Ordinary Springs and 11-ft. on Neaps, and the Inner Harbour is available for the reception of vessels usually employed in the coastal trade, and can accommodate vessels up to 2,000 tons gross register. Approximately 6,000 lin. ft. of quayage encloses a sheltered area of about 12 acres, and a good bottom exists upon which vessels may "ground." To the West, the North and South Quays are connected by means of a permanent bridge, and to the East, communication is provided by means of a hydraulically-operated swing bridge of 180-ft. span.

The quays of the Inner Harbour, which are devoted entirely to goods trade, are surfaced with mastic asphalt over reinforced concrete; they are illuminated with mercury vapour lighting, and are modernised to make the harbour available for the requirements of the present day coastal trade. Mobile petrol craneage is available on the North Quay.



Peel—Inner Harbour [Isle of Man Times Copyright

Outer Harbour

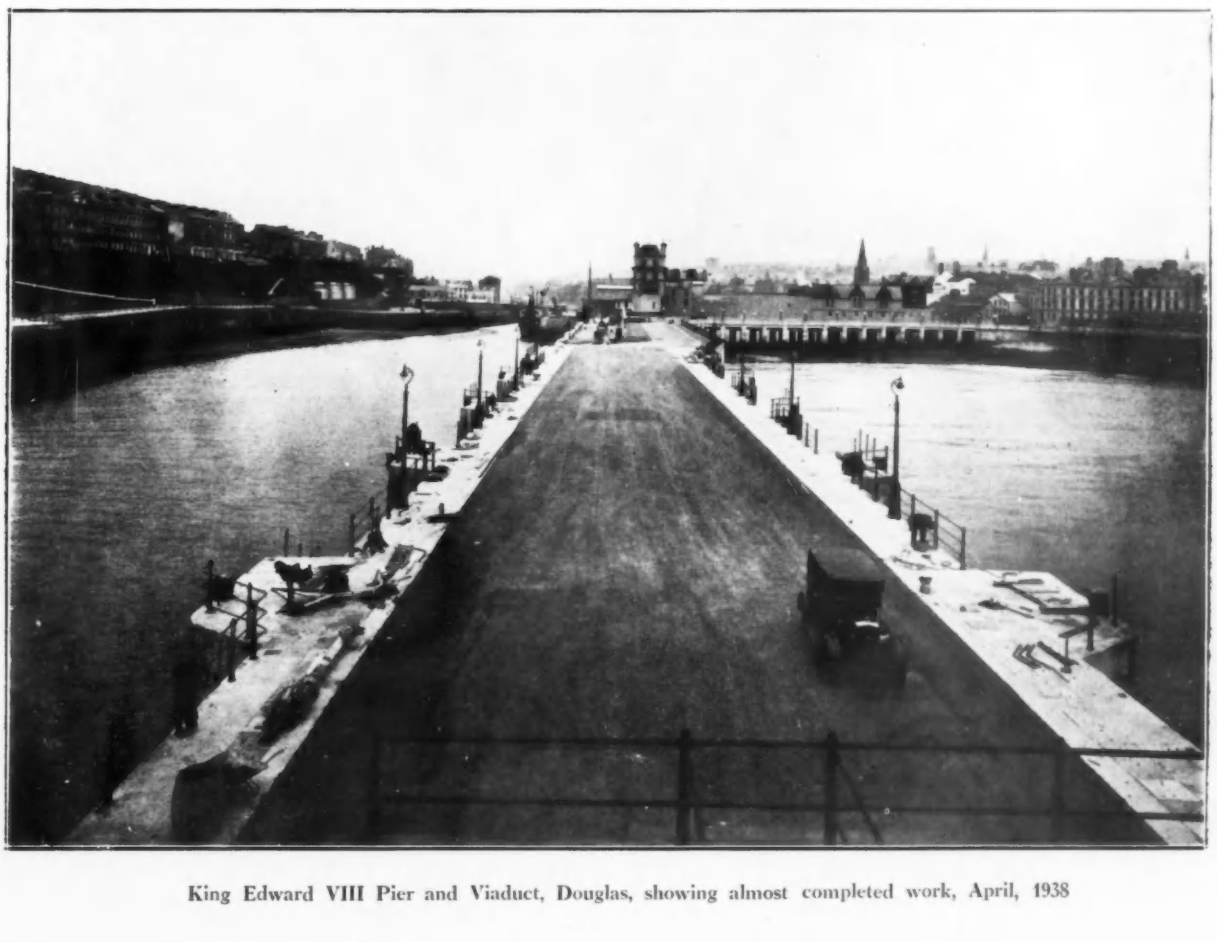
The Outer Harbour embraces a water area of approximately 30 acres, and can accommodate shipping up to 10,000 tons gross register, which require flotation at all states of the tide.

Harbours of the Isle of Man—continued

Aerial view of Outer Harbour (1935), showing King Edward VIII Pier in Process of Construction

This part of the harbour is almost entirely given up to the accommodation of passenger vessels, and 3,000-ft. of low-water berthage is provided for this purpose, although goods traffic is not infrequently handled at the Battery Pier, where cranes (one steam 20-ton, one steam 5-ton, one electric 35-cwt.) are provided for the use of cargo vessels. Mobile petrol-driven cranes are provided at the Victoria Pier and King Edward VIII Pier for the handling of motor cars, motor cycles and deck cargo conveyed by the passenger vessels.

The harbour entrance at night shows a fixed red light on the port hand and a fixed green light on the starboard hand, to vessels approaching from sea. The entrance to the Outer Harbour measures 470-ft. in the clear and faces approximately North-east. In facing this position, its exposure to the Easterly aspect is obvious, and storms from an arc North-east, through East to South-east, give rise to no little trouble. From North-east to East, however, storm is accompanied by a sea of more display of surface agitation than vice, and shipping can there-



King Edward VIII Pier and Viaduct, Douglas, showing almost completed work, April, 1938

Harbours of the Isle of Man—continued

fore be accommodated to a large extent; but storm from a South-easterly source is accompanied by a sea with a vicious swell, and on occasions, which are fortunately infrequent, renders the Outer Harbour at Douglas troublesome for shipping. Protection from storm from the latter source in particular leaves something to be desired, but in all such cases the best has to be made of the circumstances which obtain, for no situation of a port can be considered perfect, from a physical point of view, and artificial means seldom attain the desired characteristic of perfect shelter.

Tides and Wind

Within the precincts of the harbour, the flow from the river and influences from external flow of tides causes little disturbance to shipping. The flow is responsible for certain siltage, but this is adequately dealt with by the Commissioners' dredging craft. At the harbour entrance, however, there exists a considerable "tideway," particularly on spring tides, but this flow in its regularity and "set," southward across the harbour entrance on both flood and ebb tide, presents little difficulty to the navigator upon entering or leaving the port.

The nature of the "tidal set" across the harbour entrance is interesting, in that for a period of nine hours, extending from "three hours' flood" to the following "low water," it persists in a southerly direction, and for the remaining three hours slack water prevails. The explanation may be found in the following:—The "set" of the coastwise flood stream is in a north-easterly direction from Langness to Banks Howe, the most easterly point in the vicinity of Onchan Head. It is there "split" by this promontory giving rise to an "indraught" which passes along the shores of Douglas Bay in a southerly direction, proceeding along the north side of the Victoria Pier, from its root to its point, and so on past the harbour entrance and Douglas Head to again join the main flood stream. The coastwise ebbing tide gives rise to the same characteristic set southward across the harbour entrance. The main ebb stream sets from Banks Howe in a south-westerly direction to Langness, and taking with it the receding water of the Bay, gives rise to a tidal set from the shores of the Bay along the north side of the Victoria Pier from root to point, continuing in the same southerly direction past the harbour entrance and Douglas Head, to join the main ebb stream setting south-west.

Not infrequently wind direction exercises considerable effect upon tide levels at Douglas Harbour. In periods of heavy wind from a northernly direction, "cuts" have been experienced in the high-tide levels and at low water with the wind in this direction, water levels have been recorded as much as 3-ft. 6-in. below the calculated Almanac levels. A "heaping" effect is experienced with winds from a southerly point, and tides have been recorded exceeding the predicted level from the Tide Almanac by as much as 2-ft.

It is interesting to note that the "cutting effect" produced by northerly winds is considerably greater than the heaping effect produced by winds from a southerly point; but an explanation may be found in the contour of the sea-bed of the channel. Between the Isle of Man and the adjacent English coast comparatively shallow water exists, whereas southward, toward Holyhead, much deeper water and greater area prevails. The northerly winds, therefore, tend to drive the shoal water southward from the Island into an area of great expanse and depth, whereas the winds from a southerly point have to perform the more herculean task of driving the water of this great expanse and depth into a shallow and more restricted area.

Passenger Traffic

The traffic development of the harbour may be confined, for the most part, to a century, and particularly to the latter half of the 19th century.

Primarily, such a traffic can be definitely ascribed to the later development of the great Port of Liverpool, and to the great area with which that port forms contact. This development is embraced by the early years of the 19th century, when the cotton industry and mineral wealth of Lancashire were being developed with the aid of engineering skill and mechanical inventions, to such a degree that the economic condition of the people was being transformed. The balance of wealth and population was in consequence moving northward from the south, and in this century, Lancashire and the north-west of England, became an area of great activity. The advent of steam, too, was the harbinger of an upheaval in sea and land transport, and in this new era the appearance of the steamship not only brought Douglas into close, comparatively comfortable and regular contact with Liverpool; but by virtue of the great railway developments of the period, Douglas was also brought into contact with the great hinterland of Liverpool, which embodied contact with the busiest tract of land in Great Britain. It is not surprising, therefore, that the jaded citizens from the swarming industrial towns of the West and North, should seek health and recreation in the Island of Mann, or is it less unsurprising that the people of the Island were prompt to take advantage of a new opening for trade. Nature had blessed and provided the latter with an Island home of undefinable beauty, and this they offered as a holiday resort to the massed millions about her, who, through the grime and smoke of industry, yearned for the sight of its green hills and the scent of its sea-laden air.

Vague information only of the passenger traffic of the port can be obtained before the imposition of the passenger tax in the year 1883. Before the year 1767, any communication between Douglas and Liverpool was by means of vessels sailing at irregular intervals; but in that year the British Government established a regular "Packet" boat for the conveyance of passengers and mails. By the year 1793, however, traffic had enormously increased, and by 1805, six regular traders of 400 tons burden, together with a number of occasional vessels, were plying between Douglas and Liverpool, taking on the average eleven hours on the journey. Notwithstanding the advent of the steamship, sailing vessels continued to carry the mails and passengers between Liverpool and the Island until the year 1834; in fact, it was not until the year 1819 that the passenger-carrying steamer, the "Robert Bruce," plied regularly between

View showing interior of Passenger Shelters, Douglas Harbour

Liverpool and Douglas, although the first mention of a steamship at the Port of Douglas was on May 7th, 1816. In the year 1819, however, the steamship was receiving the favour of the public, and the "Mank's Advertiser" of that time comments upon "the general and uninterrupted influx of numerous and respectable visitors, who have almost—and it were perhaps not saying too much—more than equalled the return of an ordinary fishing"; and, the report continues, "our country has not been generally known to the respectable inhabitants of the opposite shores. Until of late, it has been considered as a barbarous coast, scarcely visited by any but the destitute adventurer or the base deserter from justice, by the dishonest debtor or the treacherous criminal; the smuggler, or the vagabond." Douglas, indeed, was then spoken of as a place "of gay society and pleasurable variety."

It is supposed that the average annual number of passengers landed at Douglas from the years 1830 to 1840 amounted to 30,000. By the year 1851, it had risen to 48,000, and twenty years later, it approached 100,000. One reason for the great increase in the numbers of visitors landed between the years 1851 and 1871, may be found in the opening of the Prince's Landing Stage, at Liverpool, on September 1st, 1857. Prior to this, the embarking and disembarking of passengers in Liverpool was almost as dangerous and uncomfortable as in Douglas before the year 1871, since there was only a small pier, which could only be approached at high water, and therefore "small boats" were employed for the most part in the conveying of passengers to and from the steamers. A vivid impression of what passengers endured before the opening of the Prince's Landing Stage is given in the following account taken from a "six days' tour through the Isle of Man," written in the year 1836, and is of interest en passant:—

"I shall not easily forget the scene which prefaced our safe arrival on board. It was nearly low water when we started: the packet was therefore some considerable distance from the pierhead; we had in consequence to go to her in boats. The shouting, bawling, pulling, tearing, cursing and swearing of the different boatmen and hired porters and partisans anxious to get the passengers on their own packets, the consternation, confusion and dismay of the parties who were hurried and tumbled into the boats, to go, they scarcely enquired where; and added to this, the busy and conflicting scene always to be observed on such a spot as the pierhead of Liverpool, surpassed anything of the kind I had ever seen."

Harbours of the Isle of Man—continued

Victoria Pier, Douglas. Typical scene during Season [*Isle of Man Times Copyright*

Aerial view of Douglas Outer Harbour (1938)

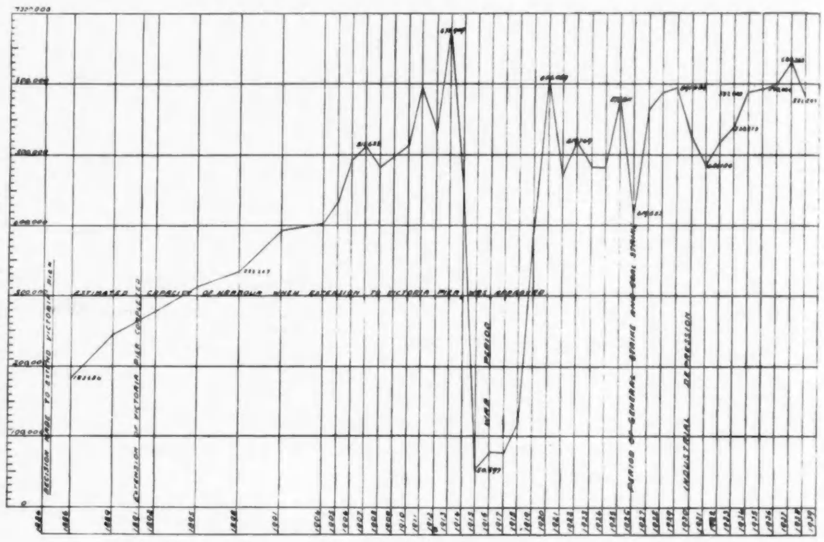
Harbours of the Isle of Man—continued

Harbour development, both in Liverpool and Douglas, contributed much to the eradication of such deplorable discomforts, and the trade continued with a natural and progressive expansion.

A "Passenger Landing Chart" is shown on this page, indicating the number of visitors landed at Douglas at regular intervals since the year 1866, and from this a uniform increase in the trade will be observed, reaching a maximum in the year 1913, when 672,919 persons were landed at Douglas Harbour. From 1914 to the year 1918, the effects of the Great War are evident, but the rapid recovery after the war is noteworthy, and in the year 1920 the industry again attained its former prosperity in showing a return of 606,059 passengers landed. The landings indicated upon the chart represent individual landings only, and require to be doubled for re-embarkation, which brings the number of passengers embarked and disembarked at the port to considerably more than one million annually. During the "peak" of the seasonal traffic, as many as 68,372 passengers have been dealt with in one day, necessitating the arrival and departure of over thirty large passenger-carrying vessels.

The chart forcefully illustrates the extent to which war, industrial unrest and industrial depression, have left their impress upon the Island's vital industry, and pronounces the importance of a "visiting trade" to the Island's people, which admits of no dispute, and although Douglas Harbour is capable of dealing with the usual coastal goods trade, the preponderance of its passenger traffic over its goods trade is indubitable. The existing harbour, therefore, may be described as a specialised harbour where works have been conceived and developed to cater for the needs of the visitors to her shores.

Available records of the goods trade of the harbour reveal a practically inert exports trade against a moderate import trade, instigated, for the most part, by the influx of visitors, although in latter years it has been augmented by the rising imports of oil, to meet the demands of increased motor transport, etc., and also to developments in the electricity and gas undertakings, together with certain building developments which were left in abeyance during the war period.

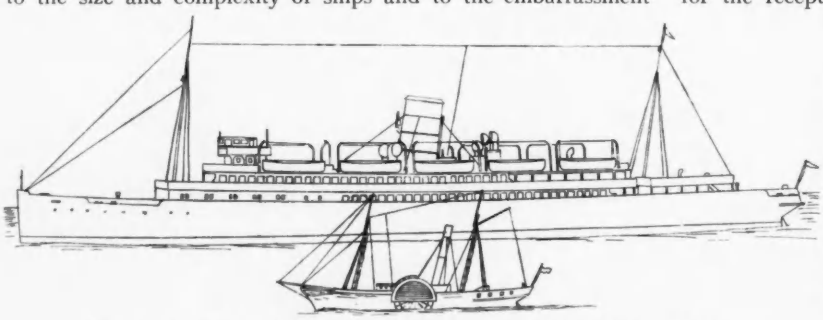


Passenger Landing Chart

The number of passenger and cargo vessels, with their net registered tonnage, which entered the port between January 1st and December 31st, 1938, is as follows:—

Passenger Vessels	= 1,039	Net Register Tons	= 912,015
Cargo Vessels	= 915	ditto	= 185,629
Total	= 1,954	Total	= 1,097,644

Concurrently with the increasing passenger trade is the increase in size of shipping. Early in the 19th century, the enormous future possibilities of steam had become apparent, and within the span of a human life, it has added enormously to the size and complexity of ships and to the embarrassment of those responsible for harbours. Although the main development of Douglas Harbour belongs to a later period, it has been a considerable problem to keep pace in her harbour works with the subtle changes in design and demands of modern shipping. An illustration is provided of vessels using the port in 1832 and in 1932, a period of one hundred years, and it is interesting to note that the vessels have passed through a progressive stage of development, from an unpretentious wooden craft of not more than 150 tons—the precursor of the present Manx service of steamers—and capable of a speed of barely nine knots, to a sumptiously appointed steel vessel which races across the channel with her human freight of 2,600 souls, at a speed of 23 knots.



Comparative size of Steamers "Lady of Mann," 1932, and "Mona," 1832

The illustrations of the two steamers have been selected from the records of the Isle of Man Steam Packet Company, a highly efficient and up-to-date Company, which has traded uninterruptedly by steam alone for over a century, and which is responsible for carrying the bulk of the passengers to and from the Island. The Company has in its service steamers, the design, speed and accommodation of which render worthy of inclusion amongst the finest cross-channel steamers afloat, and on the "peak" days of the traffic every year, these vessels carry vastly more passengers than are carried on any other cross-channel passenger service in the British Isles.

The foregoing figures and details reveal an amazing passenger traffic for an Island with a resident population of barely 50,000 people, and Manxmen are to be commended for the vigour and enterprise they have shown in fostering and catering for a trade of such magnitude.

There must be of necessity the utmost despatch in handling the great influx of visitors, coupled with every available convenience, two characteristics difficult to obtain when dealing with large numbers in a comparatively small harbour; and it is only the foresight of efficient bodies of Harbour Commissioners, past and present, together with the skill and ability of the servants whom they have enlisted in their service, which has made such possible without accident of a serious nature, year in and year out.

PEEL.

Peel—Manxland's City—with its quaint winding streets, its ancient Castle and its ruined Cathedral, lies on Peel Bay on the West Coast of the Island. The Inner Harbour is formed about the mouth of the River Neb, where extensive quayage and piers provide a tidal basin of nine acres in area. A fine masonry structure, 700-ft. long, extends from St. Patricks Isle in an easterly direction, and forms an Outer Harbour, which is open for the reception of shipping at all states of the tide. This structure is designed to serve the dual purpose of Breakwater and Landing Pier and, on rare occasions, it has afforded accommodation for the Passenger Mail Steamers, when conditions were unfavourable for safe berthage at Douglas, and for this reason Peel Harbour enjoys the reputation of being the "back door of the Island"; it is, in fact, maintained as such.

From June to September in each year, when the herring fishing season is good, scenes of great activity are to be witnessed on the quays. Several hundred motor herring boats, principally from Scottish and Irish ports, are kept busy supplying the needs of the crews of herring curers. The barrels of cured herrings are, for the most part, exported direct to Holland and Germany.

RAMSEY.

Ramsey Harbour is situated at the mouth of the Sulby River on the East Coast of the Island, 17 miles north of Douglas. It serves the agricultural community of the north of the Island, and the principal exports are agricultural produce and brine salt.

The harbour is tidal, but at H.W.O.S.T. there is a depth of 18-ft. 6-in. at the entrance, 3,000-ft. of quayage, and a water

(concluded on page 210)

International Studies on Wave Force

By HERBERT CHATLEY, D.Sc.(Eng.), M. Inst. C.E.

A MOST valuable summary of the present position of international studies on the forces exerted by waves has recently been published by M. Inspector-General de Rouville, and MM. Besson & Pétry, Engineers, of the "Ponts et Chaussées," with collaboration by MM. Beau and Baudelaire, also of the Ponts et Chaussées. [Annales des Pont et Chaussées, 1938, Part 7, 5].

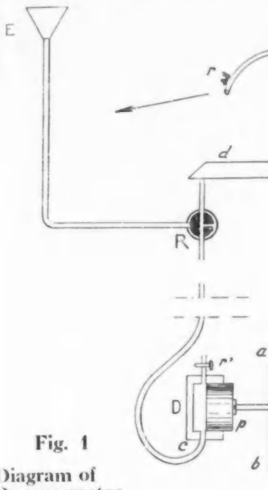


Fig. 1
Diagram of Dynamometer

This includes a note as to the development of such studies since the 1926 International Congress of Navigation at Cairo, an account of the various forms of self-recording apparatus (hydraulic, electric and piezo-electric), the characteristic dimensions of waves, the results obtained with the preceding apparatus, non-recording apparatus for measuring wave pressures, and remarks on some recent experiments at Algiers and elsewhere.

General and Historical

Arising out of the discussion on Breakwaters or Jetties in Tideless Seas, the second section of the 14th International Navigation Congress at Cairo (1926), recommended the formation of an International Committee for the study of wave force. Eventually, Chili, Spain, France, Great Britain and Germany were represented on this Committee, and the U.S.S.R. contributed a report (No. 83) on the matter when the subject of sea walls with vertical faces was taken up at the 16th Congress at Brussels (1935).

Apart from the exchange of views between members, the Committee has held, up till now, three official meetings, two in Paris (1928, 1931), and one in Genoa (1935). The reports are in the minutes of their meetings (see Bulletin of the Association: No. 6, July 1928, p. 31; No. 14, July 1932, p. 49; No. 21, January 1936, p. 66). The correspondence relative to the work of the Committee is centralised at the premises of the French section of the Association (43, Avenue du President Wilson, Paris).

The previous data on the subject have been noted, especially Captain Gaillard's book ("Wave action in relation to engineering structures"). A comparison of the different types of instruments for measuring wave forces has first been made, in order that results from different countries should be comparable. In addition, it was necessary to decide as to practical methods of measuring the height of the waves by various devices.

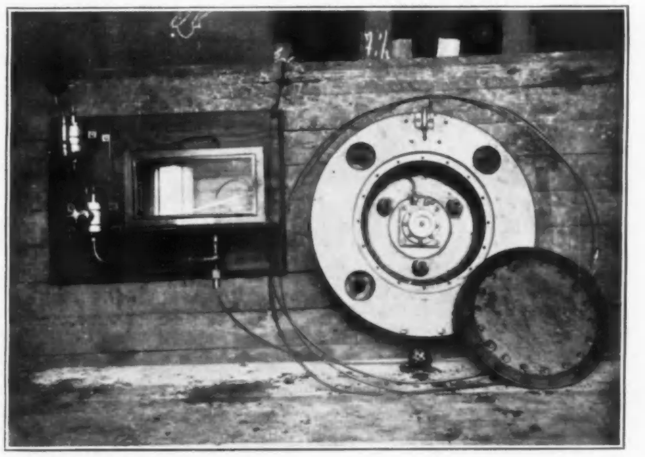


Fig. 2. General view of Apparatus, receiver open

As was remarked by the English representative, the vertical components of the wave force should not be neglected, a point which is associated with the fundamental differentiation between breaking waves and freer rollers terminating, for example, against a vertical wall. A more complicated classification of waves has been proposed, but gave rise to some doubts.

Experiments were organised at Dieppe, Havre, in Brittany, and at Genoa, and have been projected in Chili, at Gijon, Valentia, Bilbao and in Great Britain. These will be referred to later; the results were circulated to the members of the Committee over a period of nine years.

Some indications were given in 1935 on experiments desirable to be made with optical apparatus, gyrostatic systems or small mercury levels to determine the oscillations or deformations of sea walls during tempests.

The measurement of the oscillations of piles of blocks was considered in 1931, and led to a slight change in procedure in order to relate this question to the studies of wave effort on vertical walls made at the 16th Congress of 1935.

It was on that occasion that various memoirs endeavouring to develop a mathematical theory of waves reflected from a wall and interference forms were studied and extended. Some of these theories appeared to be contradictory, but it has been possible to explain their divergencies and to reconcile them practically.

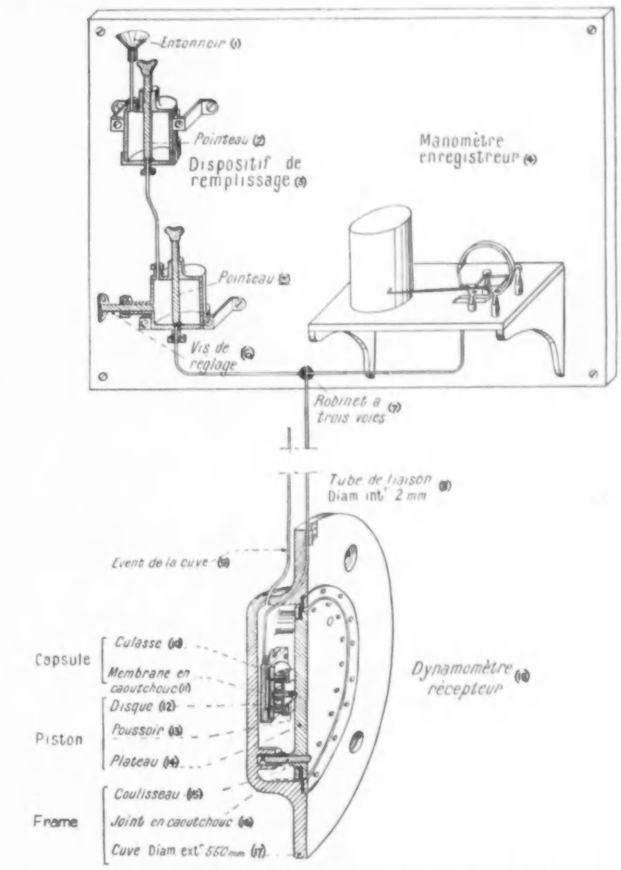


Fig. 3. Diagrammatic Perspective (half section)

(1) Funnel (2) Indicator (3) Filling Arrangement (4) Recording Manometer (5) Indicator (6) Regulating Screw (7) 3-Way Valve (8) Connecting Tube (9) Escape from Chamber (10) Case (11) Rubber Diaphragm (12) Disc (13) Thrust piece (14) Plate (15) Guide (16) Rubber Joint (17) Chamber—external diameter 550m.m. (18) Dynamometer Receiver.

Their apparent divergencies were due to the basic premisses of the authors, who were more or less venturesome in their hypotheses, more or less confident in their mathematical procedure, and more or less departed from reality in their manner of allowing for friction.

M. Bénézit (Ann. Ponts et Chaussées, 1923, II, p. 125), argued originally on the assumption of an indefinite depth of water. M. Sainflou (Ann. Pont. et Chaussées, 1928, p. 5, and 1929, I., p. 109) has sought to consider the condition, approximating more closely to reality, in which the depth is limited, but some criticism has been made as to his rates of compressibility of the water.

Both authors assume the formation of the enhanced or superposed wave ("clapotis") by the interference of two equal waves, one incident and the other reflected, thus neglecting the slight damping of the wave in propagation and reflection and the consequent inequality which occurs in the interference, even at a very small distance from the reflecting surface.

Others have not hidden their smallest theoretical doubts. M. Lira (Genie Civil, 5th February, 1927, p. 140) at first did not admit the hydrodynamic or statical theory of the superposed wave. He supposed that the orbital movement in the waves tended to continue at the vertical wall, fearing that the

International Studies on Wave Force—continued

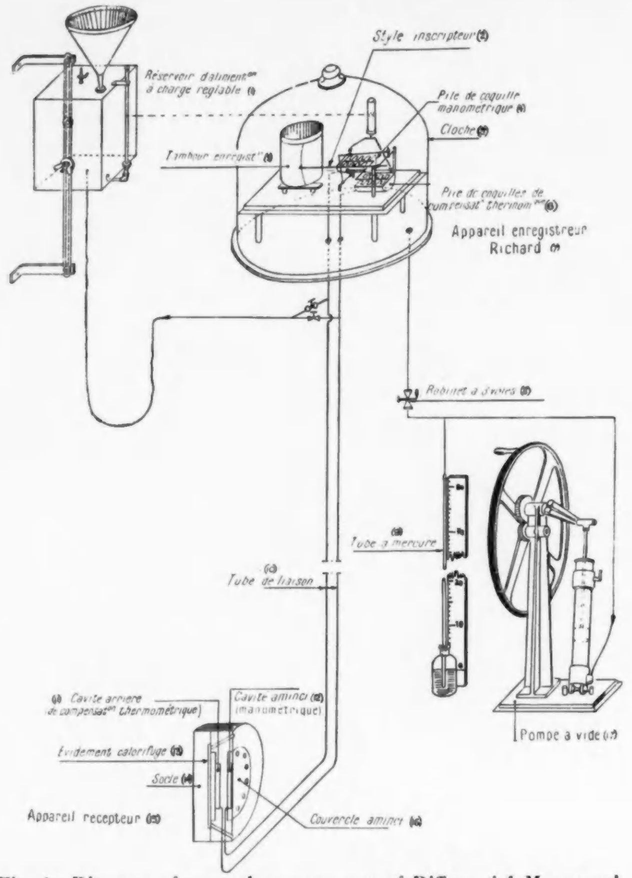


Fig. 4. Diagram of general arrangement of Differential Manograph
(1) Feed Tank with variable head (2) Recording Styles (3) Recording Drum (4) Manometer Shell (5) Bell-glass (6) Shell for Thermometric Compensator (7) Recording Apparatus (8) 3-Way Valve (9) Mercury Tube (10) Connecting Tube (11) Back Space for Thermometric Compensation (12) Narrow covered space (manometric) (13) Calorific Exhaust (14) Socket (15) Receiving Apparatus (16) Thin Cover (17) Vacuum Pump.

undeniable kinetic energy of the displaced molecules was not satisfactorily included in the equations of the French authors. He arrived, however, at results, from the point of view of pressure, slightly lower than theirs, and he finally returned to the calculations of M. Sainflou as sufficiently safe.

M. Coen-Cagli (Annali dei Lavori Pubblici, 1934, 6; Bull. Technique de la Suisse romande, 29th September and 13th October, 1934) goes much further in his doubts. At first, he found it difficult to admit even that regular superposed waves were formed by reflection, since in many cases it was evident that interferences occurred laterally, but later, he agreed that the theoretical superposition could occur in moderate seas and without appreciable local wind. In tempests, however, the spectator (or better, the cinematographer) sees a much more anarchic state of the surface. Even excluding the breaking of the mass of the roller throughout its whole height (which does not usually occur on well-designed works, but with which is sometimes confounded a superficial breaking due to local wind) there is a complex state in which several factors occur. There are thus direct waves of very unequal height and periodicity, partially reflected waves, greater according as their direction is more normal to the structure, interference between rollers from slightly different directions, due to reflection from the

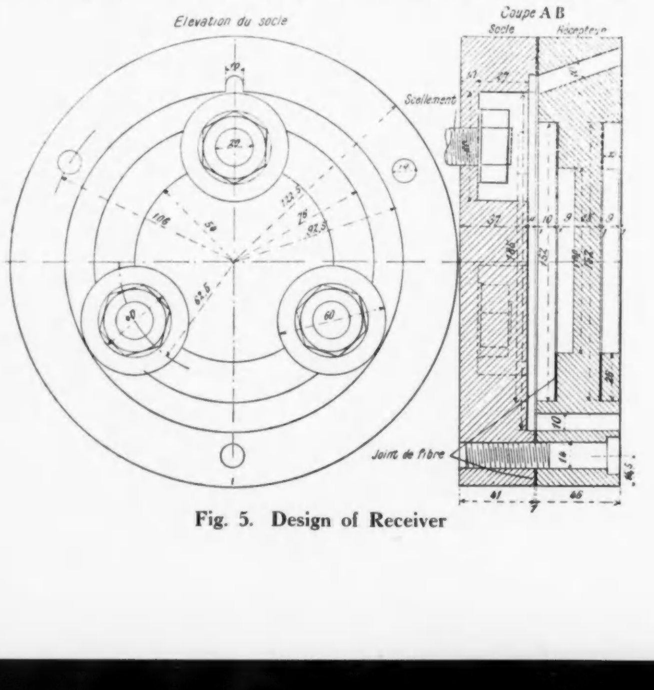


Fig. 5. Design of Receiver

works or neighbouring shores, a slight deformation of the free roller, due to the rising bottom or the projections of the substructure, etc.

Formulæ cannot express such intricacy. Simplification is unavoidable, but should not lose sight of its basis. Especially the fact should not be overlooked that the formulæ of hydrodynamics refer to small movements, whereas the oscillations of the sea over limited depths of water generally exceed "small movements," especially during storms, and these are the conditions which are critical for the structures rather than regular superposed waves.

Perhaps an exact knowledge of the real form of the wave surface, especially its maximum and minimum points, would give some support to the calculations, and here photography could be of service. One already gets an intuitive idea of the relation between the depth of a roller and the form of the culminating surface in noticing, with a model or in reality, that the tangent to the extreme crests in front of a vertical wall, remains horizontal while the wave is not deep, but that, in the opposite case, or if a strong local wind occurs, the tangent plane to the upper limits inclines more or less on account of the change of the surface of the wave, while the corresponding plane to the lower limits remains horizontal. All this, however, occurs as if an additional mass of water was superposed on the theoretical wave, but in a state of upward acceleration which prevents it from exercising any appreciable pressure on the lower layers, since the curve of observed pressures is not appreciably affected by it.

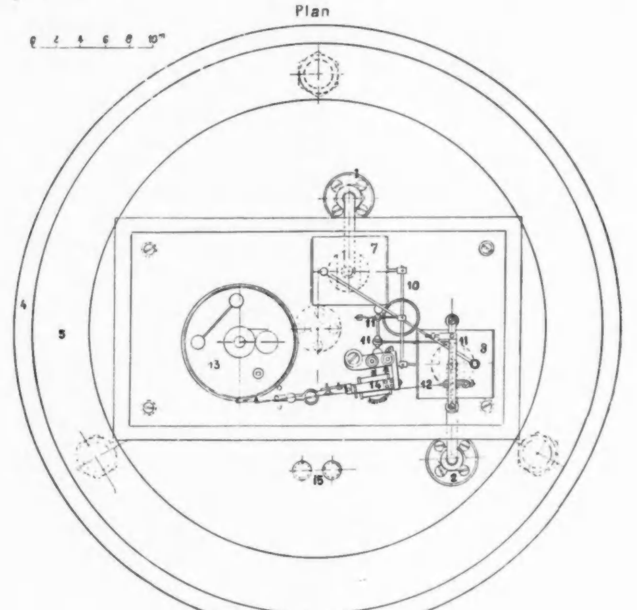


Fig. 6. Design of Recorder (Plan)

One can speak so much the better of this curve of pressure as, despite the apparent difficulties of the calculations or of the equations, the simplifying assumptions, supposing, as they do, the interference in front of a vertical wall, of two equal and opposite waves, lead to results very close to the actual magnitudes indicated by works and models. These hypotheses are even a little pessimistic, doubtless due to under-valued absorption of energy by friction, which is reassuring and useful for purposes of design.

The conclusions of the Brussels Congress on the curves of pressure can be usefully quoted here:—

"A roller of relatively gentle slopes, of which the ratio between the length 2L and the depth 2h is of the order of 20 to 25, the swelling being small in relation to the depth of the water, exercises a thrust on a vertical wall such that the distribution at the various levels may be summarised as follows:

"At the still water level the pressure is equal to the hydrostatic pressure corresponding to the depth of the free wave (2h).

"Below the still water level, the pressure diminishes slowly down to the base plane of the vertical wall, at a rate which decreased with the length of the roller: owing to the uncertainty as to this diminution, it would be wise to reckon on the maintenance of this maximum pressure down to the base plane.

"Above the still water level, the pressure decreases lineally until it attains a zero value at the upper crest level of the wave, a level which exceeds that value when the wave breaks, attaining in practice, above the said still water level, a height of the order of 3h according to observations and experiments."

International Studies on Wave Force—continued

This last expression, introduced at the request of the Italian representative, should not be understood to give the coefficient 3 an intrinsic mathematical value (instead of 2), but corresponds to actuality.

The mean level of the oscillations against a vertical wall is not the still water level. Even when the superposed wave is

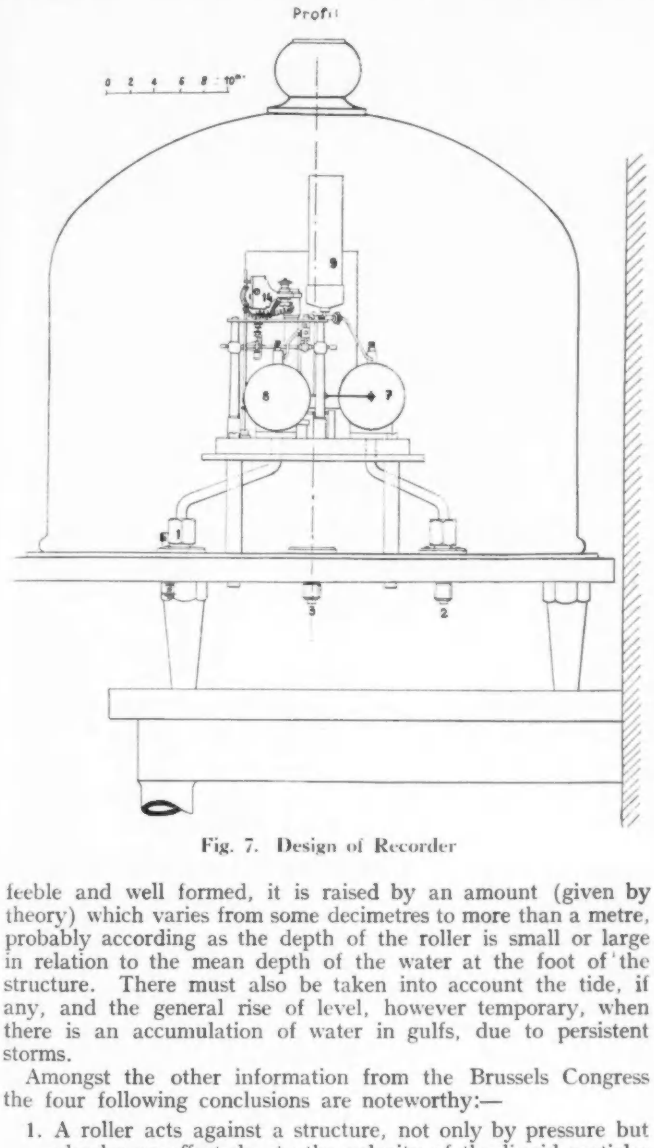


Fig. 7. Design of Recorder

feeble and well formed, it is raised by an amount (given by theory) which varies from some decimetres to more than a metre, probably according as the depth of the roller is small or large in relation to the mean depth of the water at the foot of the structure. There must also be taken into account the tide, if any, and the general rise of level, however temporary, when there is an accumulation of water in gulfs, due to persistent storms.

Amongst the other information from the Brussels Congress the four following conclusions are noteworthy:—

1. A roller acts against a structure, not only by pressure but also by an effort due to the velocity of the liquid particles which is practically horizontal near the bed. The latter is able to scour or cut down the soil and to break up the front of a rubble base, while the water filaments regain, little by little, a position parallel to the vertical wall further up. Although the "bottom flow" hypothesis leads to enormous and improbable velocities, one must nevertheless give serious attention to these currents, which appear able to attain several metres per second ($2\frac{1}{2}$ metres for 36 metres deep, $4\frac{1}{2}$ metres per second for 12 metres deep, with waves having a range of 6 metres). The simplified formulæ allow these effects to be forecast, but they exaggerate them a little, not taking friction sufficiently into account.
2. The coefficient of friction of blocks upon one another, the surface being wet or covered with weeds, needs to be reduced to 0.5 (instead of 0.7 or 0.8), and to 0.6 in the case of blocks on rubble beds. The rapid and periodic variations in the uplift, which are due to the depression of the waves, can, on the other hand, have a kind of vibratory effect capable of facilitating the shifting of the blocks by lightening them at regular intervals, and so rendering them more susceptible to external thrust.
   In any case, it is wise to allow for full uplift between the blocks and their base, even if it has been possible to increase their mutual adherence by connections between their horizontal surfaces.
3. There is reason to fear the surface diversion of waves oscillating up to the crown of a structure on account of the additional loss of weight which it causes, although it does not correspond to a true shock. Certain formulæ have been given in this respect, which should be gone into further. The fact is, in any case, one to consider, especially during the period when the wall is not completed.
4. The oscillations, now well known, of heaps of blocks, even by a feeble wave, and especially before their connection by a coping, have been studied. There is reason to attribute them principally to the passage of a roller obliquely along the wall and to the effect of the difference of level, and therefore of pressure, between the outer face and the land face where the water is calmer.

Broken waves were not studied at the 16th Congress.

Pressure Recording Apparatus

The authors next proceed to describe certain apparatus for continuous readings of wave pressure, especially those studied at Dieppe.

Prior to 1927, there was only apparatus indicating mean pressure, maximum pressure during a certain interval, or a value approaching the maximum. The variation of pressure with time is, however, very important, and commencing with a hydraulic system, first developed in 1927, this is now measurable with various types of apparatus. The authors have aimed at comparing the various types with a view to determining their most suitable applications.

Stress is very rightly laid on the ability to produce a record true to scale and phase of the original and unknown variations of pressure. Considering the latter as a periodic function, it may be expressed as a Fourier series, but it is by no means certain that the components which have various frequencies and phases will each and all reproduce in the same manner. By comparing the reproductions made by a given apparatus of known efforts, it may be discovered for what frequencies and phase relations it is insensitive. Mechanical apparatus is fallible beyond certain frequencies, which makes such unsuitable for measuring very brusque variations of force. Quartz apparatus which show differences of electric potential when the "poles" of a crystal are pressed (the so-called Piezo-electric effect) is insensitive for low frequencies, i.e., very slow variation, but it is superior to mechanical devices for rapid variations.

The first apparatus used is shown in Fig. 1, and consists of a plate ab, which receives the sea pressure and transmits it by piston p to the hydraulic cylinder (dynamometer) D, of which the bottom forms a capsule c full of water which communicates by the tube cd to the Richard (Bourdon) pressure gauge M. A three-way cock R connects the apparatus with a funnel E for charging, which must be complete and without air bubbles. During the filling, the waste cocks r and r[1] are open. This device was very hard to regulate on account of the difficulties of entirely filling the whole of the pipe system, and the simple funnel was replaced by two pressure tanks in series, as shown in Figs. 2 and 3.

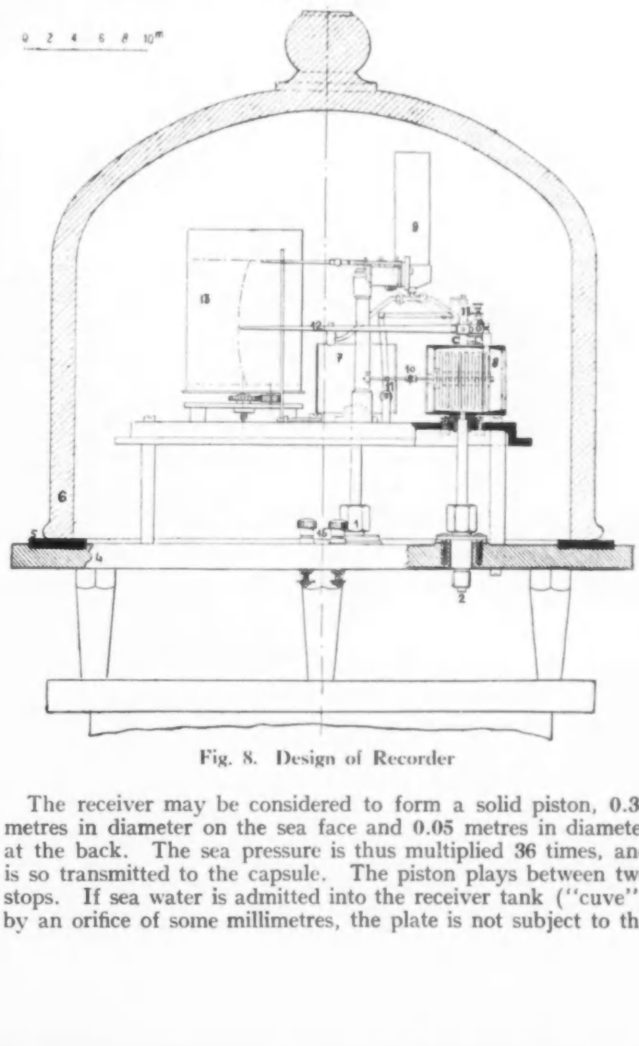


Fig. 8. Design of Recorder

The receiver may be considered to form a solid piston, 0.30 metres in diameter on the sea face and 0.05 metres in diameter at the back. The sea pressure is thus multiplied 36 times, and is so transmitted to the capsule. The piston plays between two stops. If sea water is admitted into the receiver tank ("cuve") by an orifice of some millimetres, the plate is not subject to the

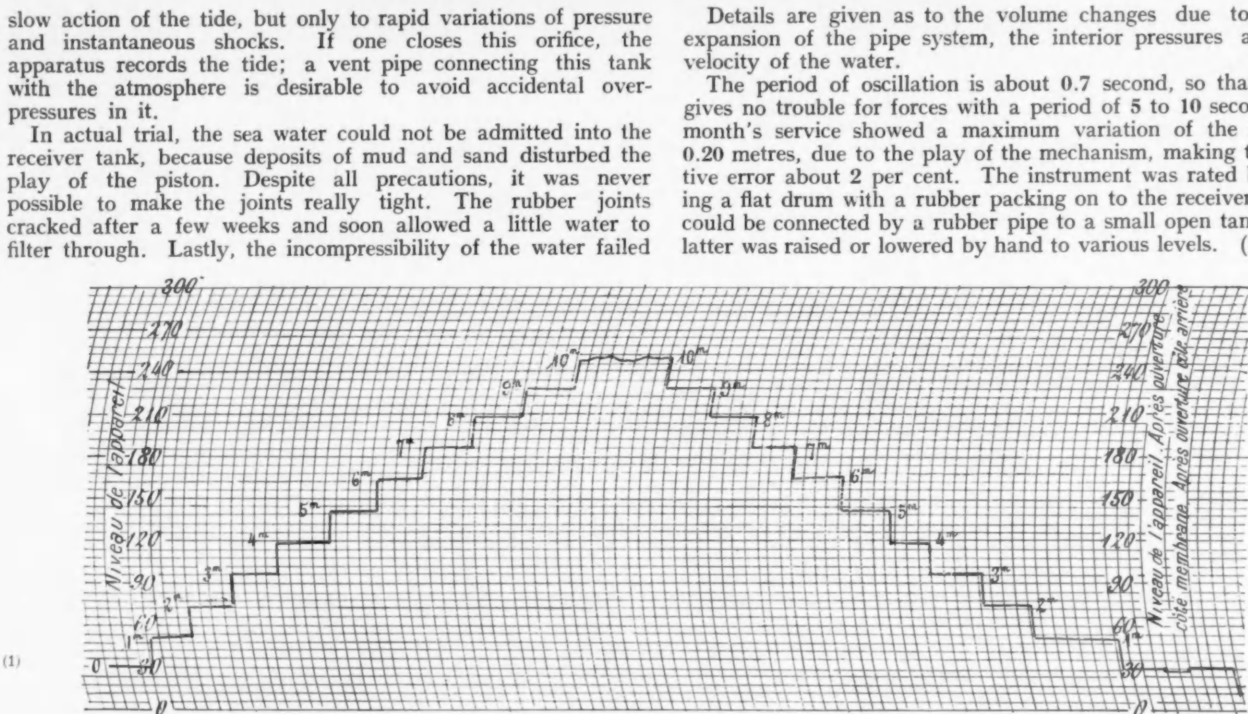
International Studies on Wave Force—continued

slow action of the tide, but only to rapid variations of pressure and instantaneous shocks. If one closes this orifice, the apparatus records the tide; a vent pipe connecting this tank with the atmosphere is desirable to avoid accidental over-pressures in it.

In actual trial, the sea water could not be admitted into the receiver tank, because deposits of mud and sand disturbed the play of the piston. Despite all precautions, it was never possible to make the joints really tight. The rubber joints cracked after a few weeks and soon allowed a little water to filter through. Lastly, the incompressibility of the water failed

Details are given as to the volume changes due to elastic expansion of the pipe system, the interior pressures and the velocity of the water.

The period of oscillation is about 0.7 second, so that inertia gives no trouble for forces with a period of 5 to 10 seconds. A month's service showed a maximum variation of the zero by 0.20 metres, due to the play of the mechanism, making the relative error about 2 per cent. The instrument was rated by bolting a flat drum with a rubber packing on to the receiver, which could be connected by a rubber pipe to a small open tank. The latter was raised or lowered by hand to various levels. (Fig. 9).



(1) Level of Instrument

Fig. 9. Rating Record

(1) (2) (3)
(1) Level of Apparatus
(2) After opening diaphragm side
(3) After opening rear side

owing to air bubbles. The zero fell by reason of the escape of water, and the sensitiveness varied with the internal pressure of the water column.

This apparatus was therefore abandoned, although it had given valuable results in registering pressures at variable depth in 1933 in Algiers, and from 1928-1934 at Dieppe. Its period was about 0.1 second. The damping was rapid and linear, corresponding to a friction varying as the speed. The sensitiveness was rather uniform.

The Differential Manograph is quite different in principle. The sea acts on a thin metal box, which is deformed. The cover of this box communicates by a stiff tube with a volume recorder. The whole is filled with liquid. (Figs. 4 and 5).

Here the first element gives an elastic reaction. The liquid column behind it is displaced; the recorder is supple and swells without causing the interior pressure to change much. Temperature effects will, however, cause the liquid to expand or contract relative to the solid container, and the recorder would indicate this change. It is therefore necessary to add a second system, identical save in the thickness of the cover, and to install a differential gear between the two hydrometers.

Thus the single stylus only records the difference of pressure on the two boxes. In practice, the two boxes consist of two cavities in the rear and front faces of the receiver, which is fixed by three bolts in a socket pinned into a suitable hollow in the wall. The front cavity is closed by a thin cover of one millimetre thickness and 100 millimetres diameter. The rear cavity is closed by a cover 10 millimetres thick. A vent in the socket piece connects with the sea above and below by 10 millimetre holes, allowing a circulation of water against the thick cover and assures equality of temperature between the two cavities, irrespective of the condition of the wall. Escapes, arranged at the top of the cavities, allow the discharge of air.

Two 5-millimetre tubes of exactly equal length connect the receiver with the recorder.

The recorder (made by Richard) includes two hydrometers, each consisting of a series of corrugated shells (as used in aneroid barometers) set horizontally in a cylindrical box: the liquid is outside the shells and the air can escape upwards. A balance weight and system of levers increases the motion of the pen, which records on a chronograph drum running at a peripheral speed of 1 or 11 millimetres per second. (Figs. 6, 7 and 8).

The whole apparatus is in bronze. Alcohol is used as the liquid in winter and water in the summer. After some trials, perfect tightness was obtained. None of the pipes is very small, so as to avoid difficulties in filling, but the time lag must not be too great in view of the duration of the forces to be recorded.

The filling is done from a transparent glass tank, which can be raised or lowered so as to keep the pressure constant. In order to remove air bubbles, a bell glass covers the recorder, and an air pump allows the production of a high vacuum, which is shown on a mercury manometer.

Readings are taken at atmospheric pressure, the bell glass being removed. An electromagnet connected to an electric clock, beating seconds or half seconds, operates a second pen, which records time intervals on the drum.

A small deviation from a linear relation between the record and the head occurred above 8 metres head, due to the bending of the thin cover plate when the exterior head exceeded the interior head.

(To be continued).

The Determination of Moisture in Timber

The Department of Scientific and Industrial Research has issued a second and revised edition of a brief pamphlet prepared by their Forest Products Research Laboratory on the determination of moisture in timber (Moisture Content Determination, Forest Products Research Bulletin No. 14, Published by H.M. Stationery Office, 9d. net).

" Practically every physical property that timber possesses," the Bulletin states, " varies with the amount of moisture that the wood contains. Strength, weight, machining qualities, shrinkage, and electrical resistance, as well as immunity from fungus attack, are dependent upon moisture content.

" Unfortunately, this quantity cannot be estimated by visual examination; many trials have shown that sight, feel, and weight are all insufficiently accurate guides to the moisture of the wood. The determination of moisture content on sound scientific lines is, however, a simple process, and the certainty that the knowledge of its value brings well repays the trouble.

" In air-seasoning, moisture content tests indicate when the timber has reached the driest possible state; and in kiln-seasoning, no quantity is more important, for the treatment is varied according to the moisture content of the stock.

" Further, moisture content provides the only sure way of telling when timber is correctly seasoned for any particular use. It has been found that woodwork assumes a definite moisture content according to the class or type of environment in which it is placed. Thus furniture in a living-room has a moisture content of 12 per cent., and if timber is to be seasoned for fabrication into furniture, it is to this moisture content that it should be dried.

"Simple conditions such as these do not obtain in a new building, for such a place is damp, although it is ever tending to its steady state. Only a simple test with timber samples is required to show, in terms of moisture content, just how damp the building is and to indicate when fine joinery can be installed with safety."

The Bulletin describes the usual method of finding moisture content from the initial weight of a sample of wood and its dry weight. A graph for working out the results, without resorting to tedious calculations, is provided. Distillation methods for moisture content determination and the precautions to be taken with resinous timbers are also dealt with. A section is also devoted to electrical moisture meters which depend for their action either on changes in the electrical resistance of wood with its moisture content or on the electrical capacity of the water and wood in a sample.

A.R.P. Problems affecting Docks and Harbours

By R. J. HODGES,
Assistant General Manager of Mersey Docks and Harbour Board

SO much is being written and said about Air Raid Precautions at the present time, and so much criticism comes from so many different sources that it is well to consider calmly the problems which arise and the best methods of solving them. A good deal of the criticism that one hears is made for purely political purposes, and can on that account be immediately discounted.

The great difficulty in dealing with Air Raid Precautions problems is that so many of them are purely speculative; there is no true precedent to work on, and whatever one's final conclusions may be in constructing a preparatory scheme, only actual experience can prove whether the scheme is on the right lines, and it is quite certain that our preparations must be sufficiently elastic to allow for adjustments to be made with as little delay as possible in the light of the experience gained, should we ever be subjected to an air attack by Continental Powers.

A squad of employees of Mersey Docks and Harbour Board undergoing training in practical decontamination work

The object of this article is to deal specifically with Air Raid Precautions affecting the docks and harbours of this country. The problems that arise in that connection are entirely different from those affecting both the civil population as a whole and most other industrial undertakings. We can go further, and say that the problems confronting each port differ considerably inasmuch as the lay-out of different ports varies so greatly, and their geographical position also has an important bearing on the question. Nor can we take it for granted that the actual experience which has been gained in the Port of Barcelona and other Spanish ports will necessarily hold good as a general rule for application in the ports of this country, for apart from the actual proximity of enemy air bases to the Spanish ports and the lack of adequate active defence weapons at the disposal of the Government forces, the climate of Spain in itself produces problems which are not to be found in this country.

Forms of Attack

Ports, similarly to other objectives of air attack, will be subject to three forms of attack, viz.: by high explosives, incendiary bombs and gas, and the first two are quite obviously the forms of attack which are most likely to be employed. A gas attack on a port may be a nuisance, but provided the necessary training of personnel has been carried out and the protective gear has been provided, the dangers of gas can be effectively counteracted. A great deal of criticism has been levelled about excessive concentration on anti-gas measures, but it must always be borne in mind that the use of gas on an area where no precautionary measures have been taken could be devastating, whilst a similar attack on an area where precautions have been taken need have little material or moral effect.

Protection from High Explosives

The measures to be taken to counteract the effects of aerial bombardment with high explosives present a more difficult problem, because it must be obvious to everyone that, whilst it is impossible to ensure protection of buildings and plant against direct hits, a certain amount of protection can be afforded against the effect of blast and splinters. A great number of buildings, such as quay sheds and pumping stations, are constructed with durable materials of substantial design in such a way as to afford a reasonable amount of protection, and it is understood from the experience afforded in Spain that reinforced concrete is the best form of construction for this purpose, and that brick construction, consisting of outside walls of not less than 14-ins., will also prevent collapse of the whole structure. With the amount of active protection which the major ports are expecting to receive from anti-aircraft guns and balloon barrages, it is reasonable to anticipate that enemy air-craft will not be able to carry out accurate low-flying attacks, and that being so, it is also reasonable to suppose that direct hits on vital points will be due rather to accident than to intention. Even if this surmise is correct, every possible step must still be taken to minimise the effect of direct hits on vital points, and this matter is one which is very much in the minds of those who are concerned in drawing up passive defence schemes.

The question of the protection of buildings from blast and splinters is one which is of extreme importance to Dock Undertakings, particularly at those ports where there is a large tidal range and the docks maintained by impounded water, as serious damage to an impounding station might result in the docks becoming tidal, with consequent risk of serious damage to shipping in them.

In addition to protecting these stations, thought has to be directed to the provision of an alternative means of maintaining the level of water in the docks wherever it is possible to do so.

Incendiary Bombs

The danger from incendiary bombs is one which must give every Port Authority the greatest concern, but here again, much can be done by the proper training of the staff of the Port Authority and employees who may be on a Dock Estate, coupled with close collaboration with the local fire brigades. It is obvious that some types of building afford very much better protection than others, and in drawing up schemes in connection with fire fighting and fire protection, careful consideration must be given to the different types of buildings and their vulnerability to incendiary bombs.

Effect on Shipping

With regard to ships, a Port Authority only becomes directly involved when a ship which has been attacked at sea, particularly by gas, arrives at port. The arrangements for the decontamination of a ship herself from the effects of Mustard Gas are a matter for the ship's crew, but in the event of cargo being contaminated and requiring to be discharged, then the Port Authority will take a hand. It is laid down in the Home Office Regulations that each port shall have a Port Anti-Gas Officer, whose responsibility will be, amongst other things, to decide what action is to be taken with a ship in such circumstances. Contamination, however, to a ship is much more likely to take place when a vessel is lying in port than when she is at sea, but the port arrangements must provide for both contingencies. It would, of course, depend on the amount of contamination whether it would be possible to discharge and cleanse the contaminated cargo in the port or whether it would have to be taken out and dumped at sea, or, alternatively, discharged at the port and destroyed. From the information available from

A.R.P. Problems affecting Docks and Harbours—*continued*

Spain, it would not appear that the number of ships which have been sunk at their moorings in the harbours have very materially affected the working of the ports, but the amount of damage which could be done to shipping lying in a port clearly depends on the severity of the bombardment and its accuracy, or in the case of bombing from big heights, the luck of the fall of the bombs. The extent to which ships are likely to be damaged would appear to be exaggerated, provided there is a reasonable amount of active defence available.

"Blacking-out"

The problem of blacking-out a port at night is one which requires a great deal of thought. It is comparatively easy to arrange for a complete black-out during the hours of darkness, but in that event, it goes without saying that no work could be carried out at night. During air raids a complete black-out will be necessary, but it is obvious that A.R.P. Schemes for the ports cannot assume complete idleness all night, and extensive experiments have been made at the ports in order to ascertain the maximum amount of light which it will be safe to use without being an obvious guide to attacking aircraft, and at the same time prove sufficient to allow work to continue.

As will be readily appreciated, skylights present the most difficult problem as, whilst the lighting inside buildings can be screened by darkening skylights, this entails continuous working in artificial light, even during day-time hours, and, apart from the additional strain imposed on the men, a reduction in the speed of working would automatically follow.

Experiments have, therefore, been made with various types of shading for the lights themselves, in order to ascertain whether the darkening of skylights can be avoided.

Some degree of lighting will also be necessary on board ships during the process of discharging or loading, and experiments have been carried out with specially shaded lights in the ships' rigging illuminating hatch openings.

As an aid to road and rail traffic using the miles of roadways to be found on the Dock Estates at the larger ports, it is probable that, as with ordinary town roads, guide lights will be arranged at essential points, and kerbs and obstructions, such as bollards, whitened. Similarly, the whitening of quay edges at river entrances to dock systems will assist in the passage of vessels through the entrances.

Organisation

The organisation of the Air Raid Precautions Scheme for a Harbour Authority is a most important matter. The maintenance of a central control of the whole Dock System during and after air raids is of the utmost importance, and therefore careful consideration of the best methods of maintaining communications is essential, and alternative means of communications must be allowed for. If the central control ceased, it is quite evident that chaos would result. For instance, one part of the docks might be seriously damaged and another part might only receive minor damage, but if the central control has been put out of touch with the docks as a whole, the additional assistance which would be required in any part where damage was severe would not be made available where it was most wanted, and in the case of the larger ports, the importance of this point cannot be over emphasised. This does not imply that local initiative is not of importance to deal without delay with any situation that might arise, but it is of prime importance that the control centre must be kept fully advised of the local conditions so that the protective measures may be applied with the least amount of delay where they are most required. Consequently, it is most important that proper training should be given to those who will be in charge at the control centre and at local centres to ensure proper co-ordination throughout the dock area and to put the system of communications to a thorough test.

It is equally important that the training of personnel should be extended beyond the details of first aid, fire fighting and decontamination, to co-ordination of the duties which will fall upon them as members of first aid, rescue, demolition and decontamination parties under war conditions.

At several ports Training Centres have been established by the Port Authorities at which their employees and, in some cases, those of Shipping Companies and others who are concerned in dock working have been trained in A.R.P. The training not only embraces theoretical and practical work in decontamination, but also covers the action which should be taken in dealing with incendiary bombs and a knowledge of blast and splinter effects from high explosive bombs. Special training in First Aid is also necessary, and it is understood that this is being undertaken at all ports.

Shelter for Personnel

The question of the provision of shelter for personnel in a dock system is one which can only be taken in general review, owing to the varying geographical and physical features of each port. As has already been stated, there are many types of buildings which afford extremely good shelter against blast and splinters, and there are also many kinds of cargo which, when lying in sheds, could easily be so arranged as to provide excellent shelter. There are also in many dock systems culverts built in concrete which could be used as trenches for the men employed in that area. In other dock systems there are open spaces in which shelters or trenches could be easily dug, but it must be borne in mind that a proper arrangement for the allocation of such shelters should be made, so that every man who is employed in the vicinity will know where to go in the event of an air raid, and confusion will thus be avoided.

Whilst the difficulty of affording protection for such a massed population as is found on the docks when work is proceeding might be eased in Municipalities by partial evacuation, this cannot be resorted to in dock areas and, in fact, it is essential if interference with the loading and unloading of vessels is to be kept at a minimum that the shelter should be in the immediate vicinity of where the men are working. This will automatically bring about a reasonable dispersion of personnel which is one of the essential rules which should be observed in any passive defence measures for protection.

General

Whilst the problems which have been mentioned above each present their difficulty, a further complication applying to the Scheme as a whole is that, in the case of several ports, the docks are within the boundaries of several Municipalities, and very close collaboration is therefore necessary to ensure the smooth working of the Air Raid Precautions Scheme applicable to the docks for which the Dock Authority is responsible.

There are, of course, A.R.P. problems which are common to Municipalities and docks, such as warning, fire fighting, ambulance service and alternative means of communication.

In most cases, it is probable that the system of warning operated by the Local Municipalities will adequately cover the docks, which is the most desirable arrangement, as uniformity in this respect is a distinct advantage, the more so if single-point control of the system can be attained. Similarly, a unified control of motor transport adapted for service as ambulances guarantees the most economical use of road vehicles, and Municipalities are, in many instances, including Dock Estates in estimating their requirements for this purpose.

The important part played by the ports in maintaining life and industry is admitted in peace time, and attention has frequently been drawn to their added importance should war unfortunately break out. For this reason, it may be expected that ports are principal targets for air attack, and the Authorities are approaching the subject of A.R.P. with this well in mind.

It can be safely assumed that progress is being made with the Air Raid Precautions Schemes of the ports of the country, and it should not be forgotten that at all ports emergencies may arise during peace time which have to be dealt with, and the main feature of such schemes is the adaptation of the existing organisation to meet the changed circumstances which would operate in war time.

Belfast Harbour Commissioners

Excerpts from Annual Report for Year 1938

The Statement of Accounts for the year 1938 shows a gross revenue of **£330,864** 4s. 0d., a total expenditure of **£309,417** 5s. 6d., and a net surplus of **£21,446** 18s. 6d., after making the usual allocations to Sinking Funds, Statutory Borrowing Bank Account and Insurance Fund Account.

The net register tonnage of vessels cleared during the year was **4,544,612** tons, being **25,605** tons (.56%) less than that of **1937**, which was the highest recorded previously.

The tonnage of goods imported and exported amounted to **3,615,564** tons, a decrease of **261,293** tons (7%) on the previous year.

New tonnage constructed in the shipbuilding yards on the Harbour Estate and cleared during the year comprised six vessels of **71,890** tons gross and **43,954** tons net register.

The work of extending the East Quay of Pollock Dock by **460**-ft. (depth—30-ft. at ordinary low water) is progressing satisfactorily, and Messrs. R. & H. Hall, Ltd., Grain Merchants, are erecting a large grain silo on land abutting on the new quay.

A 15-ton electric crane was erected at the Thompson Graving Dock to facilitate the fitting-out and repair of vessels.

The Commissioners purchased from the Ministry of Finance 452 acres of the foreshore and bed of Belfast Lough, lying between the Kinnegar and the Commissioners' Airport. It is intended to utilise this eventually for the deposit of dredged material and for the extension of the Airport.

The Belfast (Harbour) Airport was formally opened on the 16th March by Mrs. Neville Chamberlain, wife of the British Prime Minister.

The Report is signed by Ernest Herdman, Chairman, and M. J. Watkins, General Manager and Secretary.

Notes of the Month

New Grain Silo on the Clyde.

At a meeting of the Clyde Navigation Trust held early last month, it was agreed to grant the Riverside Milling Company, Ltd., berthage and conveyor facilities from Plantation Quay for a proposed new silo on an area of ground belonging to the Company, and situated to the south of the quay roadway. It is understood that the new silo will cost about £100,000.

Copenhagen Harbour Developments.

An important programme of harbour improvement in the Southern Section of the Port of Copenhagen has been decided upon, and is about to be undertaken under the auspices of the Government, the City Corporation and the Port Authority. It is estimated that the cost of the scheme will be about 13 million Kroner, and that work will be provided for about 600 men for four years.

New Floating Dock at Constanza.

A floating dock, recently provided by the Commercial Administration of Ports and Navigable Waterways for the Port of Constanza, Roumania, has a length of 145 metres (475.73-ft.), and an internal width of 23.50 metres (75.10-ft.) with provision for a depth of water over keel blocks of 6.80 metres (22.31-ft.). The lifting capacity is 8,000 metric tons (7,874 tons avoir). The dock is equipped with two cranes of seven tons capacity each.

Dover Coal Dues Bill Rejected.

The Dover Coal Dues (Abolition) Bill which was promoted by the Dover Gas Company, Messrs. P. Hawksfield & Son, Ltd., and Messrs. Hoare, Gothard and Bond (Dover), Ltd., and sought to abolish duties on sea-borne coal brought into Dover was further considered, early last month, by a Select Committee of the House of Commons, presided over by Sir Alexander Russell. The Bill was rejected, the Committee finding that the preamble had not been proved.

Port of London Authority Anniversary.

The Port of London Authority attained the 30th year of its existence on the 1st ultimo. Two of the original members, Lord Ritchie of Dundee, and Sir Ion Hamilton Benn, are still serving on the Board, the former since 1925, as Chairman of the Board, and the latter as Chairman of the Law and Parliamentary Committee. One or two other members have long records of service. Mr. J. D. Gilbert has been a member since 1913, and Sir Arthur Cory-Wright with Mr. Owen H. Smith since 1919.

Development of the Port of Ballina.

A movement is on foot to secure development of the Port of Ballina, Queensland, and legislation is proposed for the establishment of an advisory board, to be known as Richmond Port Advisory Board, Ballina lying at the mouth of Richmond River. It is stated that works, estimated to cost £350,000, are essential. They include the removal of an indurated sand barrier in the river channel, the extension of the existing breakwaters and the construction of a training wall at the north creek.

Channel Widening Programme at the Port of Stockton, Calif.

A project for the widening of the approach channel to the Port of Stockton, which is now in hand and will cost approximately one million dollars, will be completed probably in about a year. It consists of an increase of 50% in the minimum width of the waterway, the bottom of which is being increased from a minimum of 150-ft. to a minimum of 225-ft. This will allow greater ease in the passing of vessels, and these minimum dimensions apply only in the upper 15 miles of the waterway. In the lower reaches, the narrowest portions are 300-ft., and they will be increased to 400-ft. or more.

Port of Bombay Budget Estimates.

The year 1937-38 closed with a surplus of Rs. 23.58 lakhs, the highest since the inception of the Trust in 1873. The preceding two years also produced surpluses of Rs. 14.74 lakhs and Rs. 2.26 lakhs, respectively. Prior to this, the period of five years from 1930-31 to 1934-35 had been one of continuous deficits, aggregating Rs. 55.95 lakhs. The recovery during the last three years had, therefore, been somewhat rapid; and some reaction was not unexpected. This reaction did, in fact, take place even before the close of the year 1937-38. By December, 1937, the trend had become definitely downwards, due to several causes, viz., the political tension in Europe, the Sino-Japanese conflict and the heavy fall in commodity prices, etc. The Port Authority have accordingly issued a revision of their estimate for the year 1939-40.

Thames River Traffic.

A census of river traffic taken at Gravesend over a recent period of four weeks showed that the average number of vessels of all kinds passing Gravesend each 24 hours during the period was 580. The largest number on any one day was 681.

Drag Suction Dredger for Basrah.

On behalf of the Iraq Government, an order has been placed with Messrs. William Simons & Co., Ltd., Renfrew, Scotland, for a large drag suction hopper dredger. The vessel, which will have a gross tonnage of about 2,500 tons, will be for service at Basrah, and will be the fifth dredger constructed by Messrs. Simons in recent years for service at that port.

London Building Acts and the Port Authority.

Lord Merthyr's Committee of the House of Lords recently considered the Bill promoted by the London County Council to amend the London Building Acts, and among other exemptions, decided that buildings on dock premises belonging to the Port of London Authority, should retain their present exemption from the by-laws.

Belgo-Dutch Port Agreement.

An agreement between the Belgian and Dutch Governments was signed in Brussels on April 3rd, in relation to the adjustment of the surtax on through traffic to and from Alsace-Lorraine with Belgian and Dutch ports, and also on the re-partition of Rhine traffic between the same ports. It is stated that the agreement does not bring any direct benefit to the Port of Antwerp, but that it puts on record official recognition of the participation of Belgian ports in Rhine traffic.

Abolition of Autonomy at French Ports.

By a decree dated March 20th last, two French ports, Bordeaux and Havre, have ceased to be autonomous, and have reverted to the status of the generality of ports in France, which are under government control. The only remaining exception is Strasbourg. The step has excited a considerable degree of criticism, and opposition has been voiced by the Association des Grands Port Français, which passed at a recent meeting a strong resolution demanding the cancellation of the decree.

Further Improvements Recommended at Durban Harbour.

The Committee recently appointed by the South African Government to investigate the future of Durban Harbour, have issued a report which recommends that, when the improvement scheme now in hand has been completed, another should be begun. The new scheme includes, among other recommendations, the reclamation of the marsh area at the head of the bay, the provision of new wharves near the graving dock, and the construction of a new civil aerodrome near the flying boat base, which is now being built.

Shipping Catastrophe in French Port.

A mysterious and calamitous occurrence towards the end of April was the ravage by fire of the French (Compagnie Générale Transatlantique) liner "Paris," while berthed alongside the quay in the Tidal Basin at the Port of Havre. Considerable damage was done to the internal structure of the vessel, and finally she heeled over on one side with the keel exposed. A number of fine art treasures on board, destined for the World Fair at New York, were fortunately removed in time, and a large consignment of gold and valuable jewellery was unshipped before the capsizal. The vessel was reported to be still afloat in about 40-ft. of water. She was built in 1921, and has a gross tonnage of 34,569 tons.

Improvements at Otago Harbour, New Zealand.

Tenders were recently called by the Otago Harbour Board for the supply of piles and decking for the George Street Pier at Port Chalmers, and it is hoped that this work will be put in hand within the next few weeks. It is anticipated that the Birch Street Wharf, which has been undergoing extensive repairs for some considerable time past, will be opened during May, thus providing accommodation at the port for two more overseas vessels. A portion of the berth has recently been dredged to a depth of 25-ft., and when the wharf is opened it will carry three sets of railway tracks, as well as crane rails, with the result that facilities for the convenient handling of cargo will be considerably improved. The Board's dredging programme has also been accelerated, and dredging is being carried out in both the Upper and the Lower Harbours.

The Renewal of Gates to No. 1 Dry Dock at Southampton

By W. E. PARSONS, B.Sc., Stud. Inst. C.E.

Introductory

NO. 1 DRY DOCK at Southampton Docks is the oldest dry dock in the port, and was opened in 1846. The side altars are of stone, while the curved bottom and the lower part of the sides are of brick. The dock was lengthened prior to 1872, deepened in that year, and again lengthened in 1881, and is now 400-ft. long from cill to head. The width of the entrance is 66-ft., and there is 19-ft. 6-in. of water over the cill at high water of spring tides. There is a system of brick culverts, for the most part elliptical 4-ft. high and 3-ft. wide for flooding and emptying the dock.

The pair of gates immediately preceding those now to be described were built in 1870, and were probably the second pair. they are shown in illustration No. 1. Their condition caused some anxiety in 1915, and they were then strengthened by the addition of steel ties at the bottom. In 1934 they had deteriorated so as to be unsafe, and the dock was placed out of use.

The old gates were built of timber. The greenheart heel and mitre posts were connected by 20-in. sq. oak ribs. The planking was pitch pine. The lower end of each heel post was carried on a cast-iron pintle set in the dock floor, with a wrought-iron strap secured to an anchorage around the upper end. The mitre end of each gate was carried on a roller which ran on a circular cast-iron path. The heel post was rounded and fitted into the stone hollow quoin. A clapping timber at the bottom came against the clapping cill. The gates were rendered watertight by the nicety of the fit of the clapping timber to cill, heel post to hollow quoin and mitre post to mitre post.

1. The old Gates from the inside of the Dock

The gates were operated by chains from the mitre posts, guided by cast-iron rollers to hand-winches on the dock side.

A walking-way was provided over the top of the gates.

The oak ribs were badly decayed and worm eaten, especially at the scarfs and the ends. The sheeting was also decayed and worn, but, except for slight worm attack and water wear on the surfaces, the greenheart posts were in good condition.

The works carried out were: the provision of a new pair of gates, repair or renewal of clapping cill, hollow quoins and roller path.

The Temporary Dam

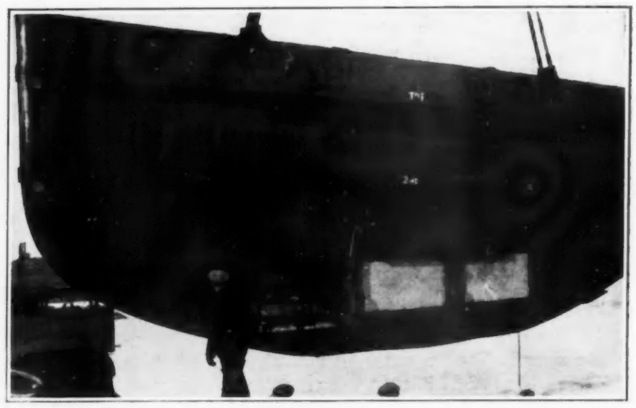
The first work put in hand was the provision of a temporary dam across the dock to permit of the repairs to the dock structure being carried out.

In the entrance walls, about 46-ft. outside the gates, there was a vertical groove, about 14-in. and 13-in. deep. This groove was continued across the invert of the dock except at the centre, where it died away. It was decided to make use of this groove for the dam.

Alternative schemes were considered for timber dams with vertical sheeting or with horizontal sheeting. It was decided to construct a dam with vertical sheeting, and as a 150-ton floating crane was available, it was decided to construct the dam on an adjacent quay and lift it bodily into its groove.

The illustration (No. 2) shows the temporary dam. The planking was 10-in. thick, formed of 10-in. by 12-in. Columbian Pine, and caulked with Oakum and marine glue. There were four walings. The top one consisted of three 12-in. by 12-in., one outside the planking, and two inside. The lowest waling was made from three timbers inside and one outside.

The walings were designed as continuous beams, supported at intervals by the struts. The water level was taken at the highest recorded level of 2-ft. 6-in. below the coping.



2. The temporary Dam being lifted into position, September 23rd, 1937

Four 12-in. diameter gate valves were provided to permit flow of water through the dam at a rate sufficient to prevent pressure coming on the wrong side of the dam.

The groove for the dam was accurately surveyed with the assistance of a diver, and from the survey templates were made and checked with the groove. The planking of the dam was made to conform to these templates. In order that the dam when placed should be watertight where it met the stonework, an oval canvas pad, about 5-in. by 3-in., filled with Oakum, was fastened to the inner face of the dam, about 8-in. from the edges, except near the centre dam, where it was fixed at the level of the bottom ends of the sheeting to a special waling timber. The canvas casing was provided with an over-lap portion for nailing. The timber was notch-grooved at the pad seating.

Permanent ballast in the form of 16 tons of concrete was cast between the two lower walings, so that the weight of the dam was approximately zero with the dam in position at high tide.

The weight in air of the dam was 66 tons, its width 68-ft. 9-in., and its height 25-ft. 6-in.

On September 23rd, 1937, the old gates were removed with the floating crane.

3. Testing of Heel Post with edge template

The walking-way on the gates had previously been dismantled and wire straps fixed round the upper two ribs for lifting purposes. The gates were lifted, one at a time, clear of the pintle and quoins and out of the water; a tripping wire was then taken round the bottom of the gate and fixed to an auxiliary lifting gear of the crane. The gate was now lowered into the water and tripped into a horizontal position, with the ribs uppermost. The gate was re-slung and removed to a quay for breaking up.

* Paper read before the Portsmouth, Southampton and District Association of the Institution of Civil Engineers on November 10th, 1938. Reproduced by permission of the Institution.

Renewal of Dock Gates at Southampton—continued

After the old gates had been removed, the dam was lifted and placed flat on the water by one 75-ton lifting block on the crane. Wires on the other 75-ton block were now fixed to lifting eyes bolted to the top of the dam, and raised as the other wires were lowered, thus bringing it into a vertical position, as shown in illustration No. 2. It was lifted by the crane which travelled to the No. 1 Dock, where the dam was carefully lowered into the groove with all valves fully opened. After examination by diver, the crane released the weight of the dam.

Temporary ballast, in the form of scrap railway metals and chairs, were piled on to the walings. This ensured that the dam remained in position, and also provided the weight to form the seal at the bottom. In addition, a long spare passenger gangway for use as a walking-way, weighing three tons, was fixed on the top of the dam, so that all its weight was on the dam.

The timber shores were cut to length and placed afloat in the dock. At high tide the shores, for the first frames, were floated into position, and fixed as the tide fell. Similarly with the shores for the second tier. These two top tiers were braced horizontally and vertically with 9-in. by 4-in. timbers, and spiked on.

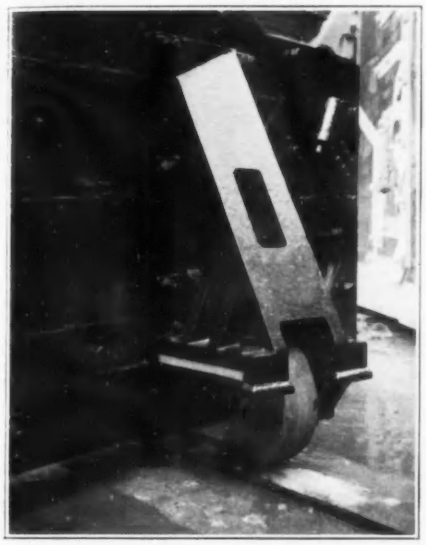
perienced after the construction of new steel gates for No. 3 Dry Dock in 1930. Again, although steel gates are probably cheaper than timber gates in first cost, their life is less, and maintenance costs are higher than for wooden gates. Also the dock was required for use as early as possible, and at that time, owing to demands for the Government re-armament programme, steel was expensive and difficult to obtain, whereas timber was readily obtainable. For these reasons it was ultimately decided to build timber gates.

It was decided to construct the gates entirely of greenheart, the reasons being:—

(1) Greenheart lasts better than any other timbers in Southampton waters, and it is practically immune from attack by limnoria (the prevalent marine insect) or teredo.

(2) Greenheart has considerably greater strength than oak and pitch pine (used in the gates being replaced).

Although greenheart is a very heavy timber (70 lbs. cu. ft.) it was felt that its use in lieu of other lighter timbers would be advantageous.



4. Cast Iron Roller and Path

5. Template of Rib of Gate

6. Reinforcement to concrete hollow quoins

At low water the valves were closed and the pumps started. The canvas and Oakum pads were compressed by the thrust of the dam on the groove, and the weight of the dam on the bottom. The pumps were able to lower the water level rapidly. As soon as the pumps started, divers sealed a number of small gaps at the meeting faces from the outside, where the stonework had previously been broken away, with hessian and Oakum pads.

When the water had been lowered sufficiently, the third tier of struts was fixed and braced. The dock was then pumped dry and raker shores set up.

As stated, the dam was shored both from the walls of the gate recesses and from the dock bottom. The side struts were built up from six 12-in. by 12-in. timbers braced together with 9-in. by 4-in., which were spiked on. Pockets were cut in the wall and timber pads fixed in to accommodate the ends of the struts. It was found possible to use two existing pockets in the floor for two of the raker shores, and the third was fixed against a cast-iron bracket on the invert bottom. This bracket had been fixed many years previously, probably for a similar purpose.

A 5-in. petrol-driven centrifugal pump was fixed on a platform, about 8-ft. above the dock floor, to keep the space between the cill and the dam, about 1-ft. 3-in. below cill level dry, while work was being carried out.

An examination of the stone hollow quoins showed they were badly worm eaten and worn top and bottom. The cast-iron roller path and pintles were also badly worn. The greenheart clapping cill was water-worn in places. It was decided to renew all of these items. Their renewal is dealt with later.

The Design of the Gates

The first point to be decided was whether timber or steel gates were more desirable.

Steel gates are usually built with two skins. The horizontal ribs, constructed of plates and angle irons, form decks which divide the space between the skins into a number of compartments. The ribs must be fairly close together at some parts of the gates, and in consequence, it may be very difficult to maintain the interior steelwork by painting. This difficulty was ex-

The old pair of gates was curved on plan, each gate having a radius of 80-ft. After considering various designs, it was decided to make the gates curved principally to keep the gates as light as possible, as greenheart was being used throughout.

The gates were considered as a form of horizontal arch, with three hinges and a uniform radial load.

The general method of design was to take a strip, 12-in. deep at various depths, and to calculate the size of rib required from the linear arch theory. The maximum stress allowed was .9 tons per sq. in.

The thickness required was 16-in. at the cill level. This thickness was carried up solid until the load was reduced sufficiently to enable a 14½-in. rib to be used. Above this point the gate was sheeted with 2½-in. thick greenheart, and it was possible to space the ribs.

The curved ribs were sawn from the baulk timber, and each was made of three lengths, as the largest width timber readily available was about 20-in. The upper separate ribs were joined by the usual scarf joint. The lower solid portion had simple butt joints. The joints were, however, broken in the layers so that generally each joint is a double strap butt joint being supported above and below by a whole timber. This fact, and the provision of the 1¼-in. bolts close to the butt on either side, considerably lessens the compressive stresses in the rib at the butt.

No account was taken of the very considerable strength possessed by the iron straps and the diagonals.

In addition, the water pressure was considered as being withstood entirely by the ribs when it is obivous that at the bottom it is transmitted directly to the cill and the load is therefore relieved for a certain distance above the bottom depending on the vertical stiffness of the gate.

Details of the gates are shown on the drawing on page 203.

The Construction of the Gates

Each gate was set out full size from the dimensions determined from a survey of the site, and templates were made for each rib, showing all joints and tenons, as shown in illustration No. 5.

As mentioned previously, each rib was in three pieces to lessen the size of the initial timber required.

Renewal of Dock Gates at Southampton– *continued*

Each piece was sawn to its template by the suppliers of the timber. The largest timber required was about 20½-in. by 17-in. for the ribs and 23-in. by 17-in. for the posts. Beds were built up by heavy timbers, shaped to receive the gates lying convex side upwards. The two finished posts were placed in their correct positions, and blocks were fixed to the bed so as to hold them firmly. The two end sections of each rib were then placed in position and finally the middle pieces were fixed. The posts were sawn roughly to size. An account of the methods of work-

7. Lifting eastern Gate into position, May 16th, 1938

ing them accurately to their final size will probably be of interest. Templates of the final cross section were made, and one fixed to each end of the posts. A piece of batten, projecting 3 or 4-ft. beyond the side of the post was fixed in the same relative position to each template. By sighting from one to the other, it was possible accurately to set the templates, and to ensure that there would be no twist in the post.

A wire was now stretched along the post, its correct line being determined from the templates. A small mild steel block was now placed between the template and the wire at each end, thus making the wire run exactly parallel to the required finished surface at that point. The timber was now chopped away under the wire at points about 4-ft. apart until a third similar block would just fit under the wire. In the case of the heel post lines of these "spots" were made at intervals round the circumference. The timber between them was then cut away, testing being done with a straight edge. The post was now polygonal in section, each side being tangential to the required finished section. The edges were then planed away carefully until the post assumed the required section.

The plane meeting faces of the mitre post were worked in a similar way, except that it was only necessary to place a line of "spots" along each side of the surface.

Illustration No. 3 shows the posts being adjusted after the gates were built, to conform to some slight irregularities in the new hollow quoins.

The clapping cill timber, both in the dock and on the gates, were also worked in a similar way. The clapping cill timber on each gate was 10-ft. deep, and was straight on one face, and curved to fit the gate on the other. The timber was about 34-ft. long, 4-in. in width in the middle, and about 2-in. at the ends. It was shaped to fit into the curve of the gate, then bolted up firmly and the final face marked off. Then it was removed and the face worked. It was then bolted back into position, and the adjustments necessary were of a very minor nature. Greenheart has a pronounced tendency to spring as the timber is cut away, and it was impracticable to work it in place as it was facing downwards.

The two diagonals to each gate were each made of two 16-in. by 16-in. lengths fitted to the curve of the gate and notched round the ribs.

The ribs were, as far as possible, left in the sawn state. It was only necessary to ensure that the sheeting bedded on the outsides of the top ribs, and that the joints between the lower ribs were as close as possible. These joints and the joints between the sheeting were caulked with Oakum and marine glue.

The butt joints in the lower timbers were formed with 6-in. by 3-in. loose tongues, which beside adding to the rigidity of the joint also increased its watertightness. All timbers were tenoned into the posts. The tenons on the 16-in. deep timber were 7-in. long by 6-in. by 9-in. deep. At their ends the size decreased to 4-in. by 9-in. deep.

The sheeting was spiked on with 6-in. galvanised mild steel spikes. The sheeting was 2½-in. thick and in 6-in. widths, grooved, with loose tongues 1-in. by ½-in. All the bolts used were 1¼-in. diameter mild steel bolts with hexagon heads and nuts and 4-in. sq. washers ½-in. thick, and were galvanised. The holes through the timber were $\frac{1}{32}$-in. larger.

All the tenons, loose tongues and bolts were set in thick red lead paint.

The lower solid portion, 9-ft. 4-in. high, was bolted vertically. This necessitated the drilling of 28 holes 9-ft. 4-in. long. Special augers for use with an electric drilling machine were obtained. A bed to align the machine was built up, and drilling commenced. The far-end of the first hole was 19-in. out of alignment. Some other holes drilled with these augers came near to the right position, but were not straight. Apparently, the worm at the point of the auger followed the heart shakes, which are usual in greenheart, thus causing the hole to deviate from a straight line.

It was fairly certain that a straight hole could be made with a shipwright's shell auger. One of these was accordingly welded to a shank which fitted the machine. With these tools it was only possible to drill about 6-in. without emptying the shell. However, the holes drilled with them were quite straight.

The wrought-iron straps were ⅝-in. thick, and were 4½-in. wide and bolted on. The various shapes were cut from wrought-iron plates with oxy-acetylene equipment. There is thus no welding in the whole of the strap work.

The filling culvert of the dock has an invert level 4-ft. 6-in. above L.W.O.S.T., and in consequence of the time taken to fill the dock, it frequently happened, especially on neap tides (H.W. 9-ft. 6-in. above L.W.O.S.T.), that before the water levels inside and outside the gates were equalised so that the gates could be opened, the tide had started to recede. This made docking ships more difficult. In order to overcome this difficulty, a 9-in. diameter cast-iron pipe was fixed through the gate with an invert level 4-ft. below L.W.O.S.T. A 9-in. controlling sluice valve was fixed to this pipe on the inner face of the gate. Thus it is now possible to commence flooding the dock at low water.

The weight of each gate was 40 tons in air, and in water at high tide was 13 tons. The length of each gate was 36-ft. 6-in., and its height was 24-ft. 3-in. The finished gates in use are shown in illustration No. 8.

Renewal of Hollow Quoins

The condition of the stonework of the hollow quoins has already been referred to. The shaped stones were approximately 6-ft. by 5-ft. and 2-ft. to 3-ft. 6-in. thick, and securely bonded into the rest of the structure.

8. The new pair of Gates from the inside of the Dock

Their complete removal would therefore have been an extensive operation, and one which might have endangered the structure of the dock, which it must be remembered is very old. An alternative would have been to cut away a section of the stone and replace it with a smaller shaped stone, There would be, however, considerable difficulty in fixing the small stone securely.

It was decided, therefore, to make a departure from usual practice, and to cut back the face for a depth of about 1-ft. throughout the height of the dock, and to replace it in concrete. Four 1½-in. diameter steel rods secured to the stone with ⅜-in.

Renewal of Dock Gates at Southampton—continued

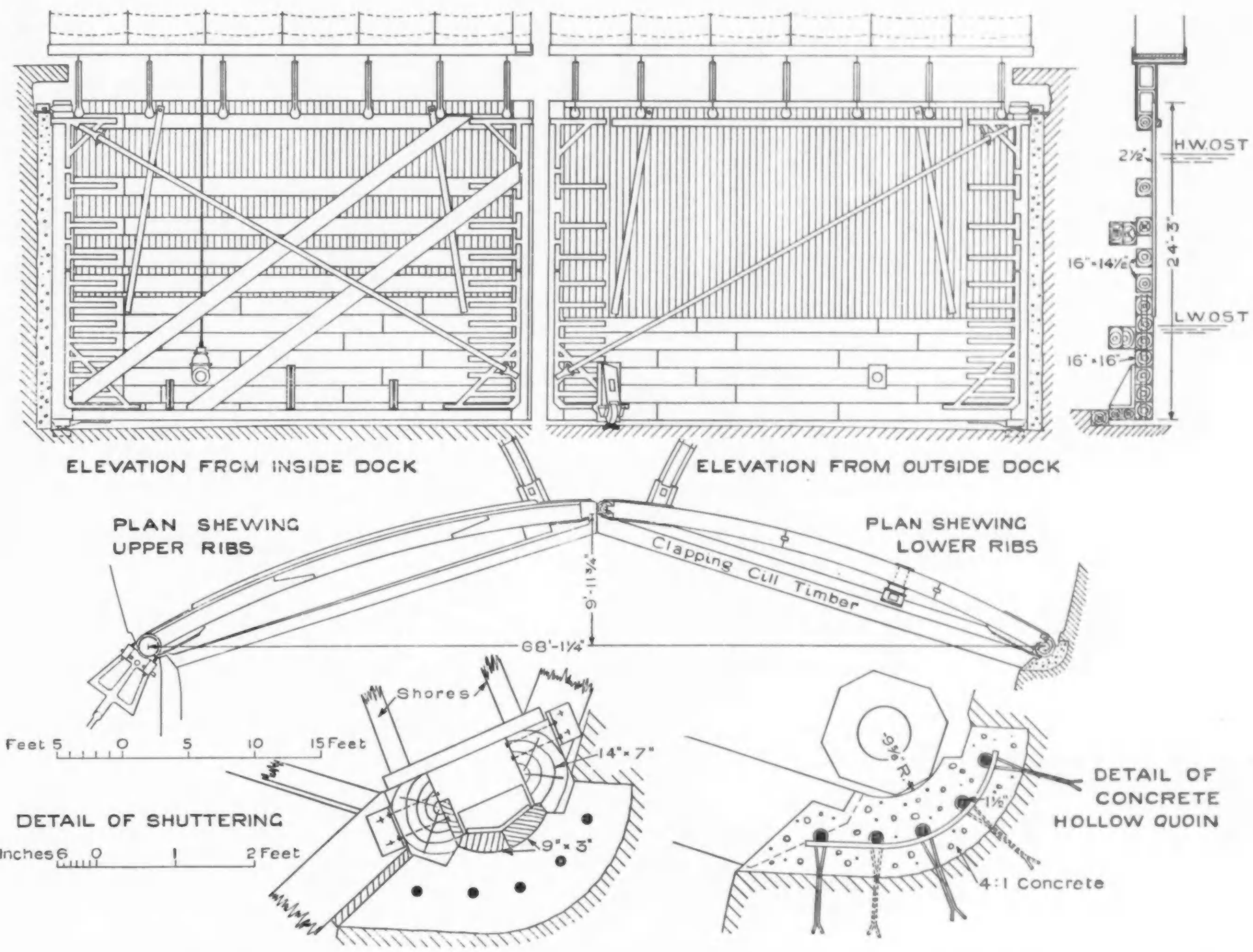
stirrups were used as reinforcement, as shown in illustration No. 6.

The shuttering had to be designed to provide, as near as possible, an accurate concrete face, to an arc of a circle $9\frac{5}{8}$-in. radius in cross section and 23-ft. 9-in. high. Concreting on each hollow quoin was carried on continuously from bottom to top, so as to avoid any junction between set and new concrete.

The shutter was made in five sections, each 4-ft. 9-in. high. Two 14-in. by 7-in. timbers were fixed vertically and very well bolted to the stonework. The sections fitted behind this timber into rebates, and were slid down into position from the top.

The western quoin was concreted first, and the same shuttering was used for the eastern. As it was of opposite hand, the top of the shutter now became the bottom. The finished face was very similar to the western quoin, and there were still slight inequalities.

These inequalities were probably caused by the section not bedding evenly on the guide timbers, and by the timber swelling unevenly as it became wet, this in spite of the fact that it had been soaked in water and had then been worked to its final dimensions. It should be noted that after the shutter was erected there was insufficient room behind it to allow of the



Each section, when placed in position, was screwed to the next and bolted to the guide timbers. The whole, before being placed into position, was worked and tested in much the same way as the heel post. The shuttering was made from red deal. Details of shuttering and hollow quoins are shown on the drawing above.

When the shuttering had been erected, the top four sections were removed and concreting started. The concrete was machine-mixed on the quay and lowered down in buckets. For workability a rather wet mix was used, and it was very well tamped with a slice-shaped tool to minimise air bubbles on the surface. Prior to the shuttering being fixed and in order to ascertain the most suitable concrete mix, and the best method of placing and tamping the concrete, several full-scale experiments were made, using one of the actual sections.

The sections were placed in position as the work proceeded, all the shuttering having previously been treated with a mixture of oil and paraffin.

The aggregate was made up from $\frac{3}{8}$-in., $\frac{1}{4}$-in. and $\frac{1}{8}$-in. to dust granite chips. The composition of each grade was obtained separately by means of a sieve analysis. From these results they were combined to give a well-graded aggregate. The proportions used were $\frac{3}{8} : \frac{1}{4} : \frac{1}{8} = 1 : 1\frac{1}{2} : 2\frac{1}{2}$ by volume, which gives the curve shown in diagram No. 9. It will be seen that this curve approximates very closely to the Fuller's curve shown on the diagram. A 4 : 1 Portland cement concrete was used.

The shuttering was struck after five days, and those few air holes which were present were filled with neat cement. The face was then rubbed down with carborundum to remove the slight arrises, at the junction of the sections. Measurements taken from a vertical wire stretched up at the centre of the arc showed the quoin to be vertical, but with local inequalities amounting at one point to slightly more than $\frac{1}{32}$-in. The heel post was adjusted to allow for this.

alignment of the face being checked. Its accuracy, therefore, depended on the sections taking the same positions as they did when in the workshop.

The quoins were of $9\frac{5}{8}$-in. radius, that is, $\frac{1}{8}$-in. larger than the heel posts.

The cast-iron pintles were placed in holes cut in the dock floor and grouted in. Each is 8-in. diameter and fits into a recess 10-in. diameter in a casting at the bottoms of the heel posts. There is a possible movement of 1-in. in any direction. The tops of the pintles are spherical with a radius of 2-ft. This bears against a dished phosphor bronze washer of the same radius. The weight of the gate, therefore, tends to register the heel post central with the pintle.

It was thought that if the pintle was set $\frac{1}{4}$-in. out from the centre of the hollow quoin the heel post, as the gate opened, would revolve clear of the quoin, and that as the pressure came on the gate as the dock was emptied, the gate would move over the $\frac{1}{4}$-in. and take up its correct position in the hollow quoin. This proved not to be the case, as will be described later.

The greenheart cill timber in the dock was 16-in. by 14-in., and fixed to the stone with horizontal and vertical holding-down bolts. The vertical bolts were screwed into existing brass sockets fixed in the floor. The heads of the horizontal bolts were covered with wooden dowels worked to the required face.

The cast-iron roller path has a bearing surface of $8\frac{1}{2}$-in., upon which the 6-in. wide roller runs. The roller is slightly conical to allow for the fact that the outside edge covers a longer distance than the inside edge. The surface of the path is accordingly sloped away from the centre.

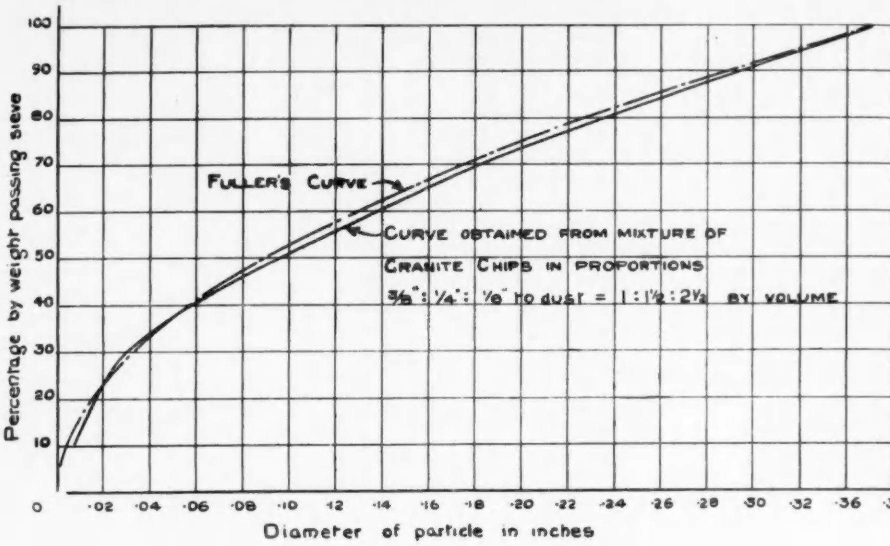
The roller is carried in a massive cast-iron bracket bolted to the gate, as shown in photograph No. 10. Vertical adjustment, both initially and to take up wear of the roller and path, is provided by means of removable packings. These packings slide in from the sides of the brackets without actually removing

Renewal of Dock Gates at Southampton—continued

the roller. It will therefore be possible to make adjustments in the future by diver. The appropriate bolts are made of phosphor bronze with this end in view. When the gates are closed the reaction at the mitre posts is sufficient to raise the roller from the track if the track is worn.

The new gates were lifted into position on May 16th, 1938. Lifting eyes had been built on to the gates, and the 150-ton floating crane was again used, as shown in the illustration No. 7.

The heel posts had been trimmed to fit the hollow quoins before the gates were placed in position, and scraping only was now required. The gate was opened to its fullest extent and the exposed part of the heel post painted with red paint. The gate was then closed and jacked over the ¼-in. into the closed position. On opening the high spots were shown, and the post was scraped accordingly. The mitre faces were also scraped to a final surface.



9. Sieve analysis curve for aggregate used in hollow quoins

The first water test on the gate was designed to test the water-tightness of the fitting of mitres, heel posts, and cills. The gates were closed and jacked over tight against the cill, and the space between them and the dam filled through the 12-in. valves in the latter. The cills and mitres were quite tight, with a small leak at the base of the heel posts. The posts were again rubbed down and another test carried out. This time the whole dock was filled, and then the gates were closed and the dock pumped out, thus reproducing ordinary working conditions. There was a bad leak at the heel posts, and it was obvious that they had not moved over the anticipated ¼-in. It was thought that possibly the back of the heel post at the bottom was binding against the concrete, and packing was inserted at the roller in an attempt to tilt the gates back slightly and thus keep the post off the concrete until the pressure was sufficient to push the gate into position. Varying thicknesses of packing were tried, and afterwards an ⅛-in. was taken off the mitre posts to shorten the gates. However, no material improvement was effected.

The cause of the trouble was now becoming clear, that long before the thrust on the gates became sufficient to lift them the fraction of inch necessary to move them over into position, the friction between the heel post and concrete, due to the reaction at the heel post, was too great to allow them to move at all. The only remedy was therefore to move the pintles. The gates were jacked up an inch or so and the pintles cut free with pneumatic tools. They were then moved over, and another test performed before they were actually grouted up again. The result was very much better. At the final water test a Vee notch was used to measure the leakage, and it was found to be about 9 pints (1.125 gallons) per minute.

It was found later, when the gates were in service, that they opened up slightly at low tide when the pressure was less and the leakage increased somewhat. This variation has decreased very considerably after four months' use, probably due to silt filling the leaks, and the leakage remains at almost the original 9 pints a minute.

It will be seen that the arrangement of the pintles to enable the gates to open with the heel posts clear of the hollow quoins had to be abandoned in this case, but if the doming of the pintles was not so severe, thus reducing the necessary upward movement, and with a lighter pair of gates, it is probable that the scheme could be successfully applied.

Conclusion

The work was designed and carried out under the direction of Mr. M. G. J. McHaffie, M. Inst. C.E., Docks Engineer, Southern Railway. The Author prepared the working drawings, and acted on the site as Assistant to Mr. C. B. H. Clark, B.Sc., M. Inst. C.E., Outdoor Assistant to the Docks Engineer.

Legal Notes

By Our Legal Correspondent

STEAMER IN COLLISION WITH DOCK WALL

A personal visit by the President of the Admiralty Division of the High Court to the East India Docks to witness the reconstruction of an accident was one of the principal features of the case of Pelton Steamship Co., Ltd., v. Port of London Authority, in which judgment was given on the 13th March last. Some conflict of evidence and a decision adverse to the Port Authority further render the case noteworthy from a practical point of view, although the legal issues involved were not particularly abstruse or unusual.

The Plaintiffs' steamer "Spero," of 1,960 tons gross, arrived at East India Docks with a cargo of fruit from the Mediterranean. As she was passing through the basin, in charge of a Dock Pilot, on her way to the Import Dock, the sluice leading from the Export Dock was opened. The "Spero" swung from her course and came into collision with the lock wall. Her owners claimed damages against the Port of London Authority, alleging that the cause of the accident was the opening of the sluice by the Authority's employees without warning whilst the "Spero" was navigating the basin. The Port of London Authority replied that the accident was due to negligent navigating and excessive speed on the vessel's part.

The case was tried by the President, Sir Boyd Merriman, sitting with two of the Elder Brethren of Trinity House. The evidence on behalf of the Plaintiffs was that the "Spero" was running off her way and proceeding at 1½ knots, just abreast of the Export Dock, when the sluice was opened and water poured into the basin from the lock. The force of water from the higher level within the lock struck the "Spero" on her port bow and swung her to starboard. Collision with the granite corner on the starboard side seemed imminent, and the Pilot went hard a-port with engines ahead. The vessel grazed a wooden fender at the corner and then a rush of water from the inner end of the lock, where two other sluices were open, forced the vessel's bows to port and her stem came heavily into contact with the wall of the lock.

The Pilot, giving evidence, said that the sluice was shut when the "Spero" entered the basin, and it was opened as her bows came abreast of it. The boil of water deflected the ship's head so that there was not time to warp and he had to take emergency action. A rowing boat could not be rowed across the boil, and he would not willingly have taken a ship past the sluice while it was open.

The Defendants' case was that it was in accordance with the usual custom to open the sluice between the Export Dock and the Basin in order to equalise the water level. The speed of the "Spero" was too high, she failed to put out a bow rope when hailed to do so, she had not a boat in attendance, and she ought not to have entered the basin without a tug. It was denied that the sluice from the dock to the basin was open when the steamer drew abreast and that the two inner sluices were open. It was also maintained that if the sluice were open, the water from the lock would not affect the heading of a ship which was properly handled.

On several points of fact the evidence of the two parties was divergent, particularly as to the time and manner of opening the sluices. During the hearing of the Defendant's evidence the trial was adjourned to enable the Judge and Elder Brethren to attend an experiment at the docks, when the sluice was opened whilst a hopper was navigating in the basin.

In giving judgment for the Steamship Company, the President said that he and the Elder Brethren had seen for themselves that when the sluice was opened the head of the hopper was deflected and she had a narrow escape from collision with the

Legal Notes—continued

lock wall, and he was unable to understand how it could be contended that the opening of the sluice while a ship was crossing the basin was a normal practice. The President found that the sluice was opened when the "Spero" was crossing the basin under the dock-master's order, and that it was not closed rapidly enough. He commented on the unsatisfactory nature of some of the evidence adduced on behalf of the Port Authority on these points, and he held that the opening of the sluice in the circumstances amounted to negligence. His Lordship also found that the inner sluices were open at the material time and that this constituted negligence.

On the question whether there was contributory negligence on the part of the "Spero," the President said that there was no ground for saying that the "Spero" was proceeding at anything but a normal and proper speed in the circumstances, and he did not believe the Defendants' witnesses who said they noticed the steamer's excessive speed. As to the contention that the "Spero" should have put out a bow rope, this would have had little effect and there was nothing in the point. Regarding the fact that the Pilot, when he noticed the effect of the stream on the "Spero," ordered full steam ahead, the President said that in the circumstances the Pilot's action was right.

This case serves to emphasise the importance attaching to the obtaining of evidence. Theoretically, this duty devolves upon the lawyer who is preparing the case for trial, but in practice, the lawyer often does not come upon the scene until a considerable time has elapsed. Witnesses' memories may by then have become dimmed and their recollections influenced, however involuntarily, by subsequent events. It is obviously desirable that statements should be taken from all witnesses as soon as possible after the occurrence of an accident. It also has to be borne in mind that an over-willing witness may prove very vulnerable under cross-examination because his evidence may be coloured by a desire to stress the favourable facts and gloss over the unfavourable ones. It is therefore most important for a witness to divulge to the party on whose behalf he is to testify anything which is adverse to that party's interests. With the whole of the evidence available and thoroughly tested, the chances of successfully contesting a case in court may be gauged more accurately and a decision more readily taken as to whether or not the expense of fighting a case is justified.

Insect Attack on Grain and Stored Produce

An Important Port Problem

The protection of grain and other stored produce against destruction by insects is a problem of growing urgency in national defence. Particularly is it of importance to port authorities who make provision for grain storage. It also affects the man in the street, individually, since the losses involved in storage are included in the price he pays for bread, beer and even chocolate. In close co-operation with the industrial and commercial interests concerned the Department of Scientific and Industrial Research has arranged for research on the practical aspects of the problem. Work is being carried out on behalf of the Department by Professor J. W. Munro, assisted by a team of entomologists, chemists, botanists and physiologists, at the Imperial College, South Kensington. Last year Professor Munro made a survey of the extent of insect infestation of stored grain and grain products in this country. During storage for short periods on farms and in warehouses the damage done by insects can be greatly reduced by giving attention to simple principles of warehouse hygiene. The survey disclosed, however, an unexpected lack of knowledge of these principles and to assist all concerned in the storage of grain the Department has issued a brief pamphlet on the subject ("Pests of Grain," published by H.M. Stationery Office, 3d. net). This describes the most common grain pests, and simple but effective means for keeping them in check. A chart, suitable for hanging in warehouses or barns, summarising the information in the pamphlet, has also been prepared and can be obtained from Stationery Office Sales Offices at the cost of 4d. (post free 6d.).

The pamphlet states that the infestation of grain by insects and other pests is in no way mysterious but only happens when the insects invade the grain from outside. The opinion that grain itself generates weevils or other insects is entirely wrong. Over 150 different kinds of insects have been found in grain or grain stores, but only a few of them cause serious damage. Of these, the most important are the grain weevils, the flour moths and the flour mites. The grain weevils are small, dark brown beetles with pronounced snouts; the moths are not unlike the common clothes moths, while the mites are tiny animals almost invisible to the naked eye, except when they congregate together. It is not the size of the insects, but the rate at which they multiply which causes the trouble. In the course of a year a single female weevil may give rise to one million offspring or more, while the female flour beetle commonly lives for at least a year and lays from one to two eggs a day. In discussing remedial measures, the pamphlet states:—

> "Insects and mites increase in numbers only when they have an undisturbed food supply and breeding ground. Obviously, therefore, neglected heaps of old grain or feeds, sweepings, old sacks, and long-accumulated debris in corners and in cracks between floorboards, form ideal breeding grounds for them; and the first step in the war against these pests is to see that no such breeding grounds are allowed to remain."

It may happen, however, that as a result of long neglect or the occurrence of the unfortunate arrival of an unusually heavily-infested consignment, the precautions described in the pamphlet to remove the risk of infestation may be insufficient; it then becomes necessary to use other methods, such as fumigant gases or insecticidal sprays. Some of these methods are already fully developed, but others require further investigation on the scientific or the commercial side, and this work is being undertaken. The pamphlet states that:—

> "Except for small-scale work, such as fumigation of corn or flour bins or of small parcels of empty sacks, fumigants should be used only by skilled operators. Advice on fumigation can be obtained from a number of professional fumigation firms operating in this country, or from the Director of the Stored Products Research Laboratory, Imperial College of Science and Technology, Slough, Bucks."

Canadian National Harbours Board

Excerpts from Annual Report for the Calendar Year 1938

Traffic

Traffic statistics for 1938 indicate that harbour activity was sustained at a relatively high level during the year.

The aggregate number of arrivals of vessels at harbours under the jurisdiction of the Board was greater than in 1937, and the net registered tonnage of all arrivals also showed an increase. The number of vessels in 1938 was 40,467 with aggregate net tonnage of 34,030,575, as compared with 40,228 vessels in 1937 having a tonnage of 32,886,863.

Water-borne cargo received at and shipped from harbours operated by the Board reached the aggregate total of 31,732,877 tons in 1938, as against 32,195,291 tons in 1937, the decrease being 462,414 tons, or 1.4%. This decline, though slight, reflects the less satisfactory condition of domestic and international trade. The aggregate volume of harbour traffic last year, however, was still about 5,000,000 tons greater than in 1935. A favourable factor in 1938 was a substantial increase in shipments of grain, as compared with 1937, when the volume was unusually low owing to the small crop.

Revenues and Expenditures

For the third successive year, there have been substantially increased revenues and reduced expenses. Operating revenues of all harbours and facilities administered by the Board amounted to $9,144,936 in 1938, as compared with $8,452,355 in 1937, an increase of $692,581, or 8%. Expenses of administration, operation and maintenance totalled $4,408,724, as against $4,598,442 in the previous year, showing a decrease of $189,718, or 4%. Operating profit for the year was $4,736,212, which represented a gain over the figure for 1937 of $882,299, or 23%.

With a larger volume of grain traffic, operating revenues in 1938 of the elevators at Prescott and Port Colborne and the harbour of Churchill were more than double those of the previous year, amounting to $402,480, as compared with $190,133. To obtain the additional revenue of $212,347, an increase of but $15,249 in operating expenses was required. The result of the year's operations, after taking into consideration miscellaneous income debits, was a surplus of $53,549, as compared with a deficit in 1937 of $137,690, or a net improvement of $191,239. No charge for interest or replacement reserve is made in the case of these facilities, with the exception of interest on a small amount of capital expended since they were transferred to the Board.

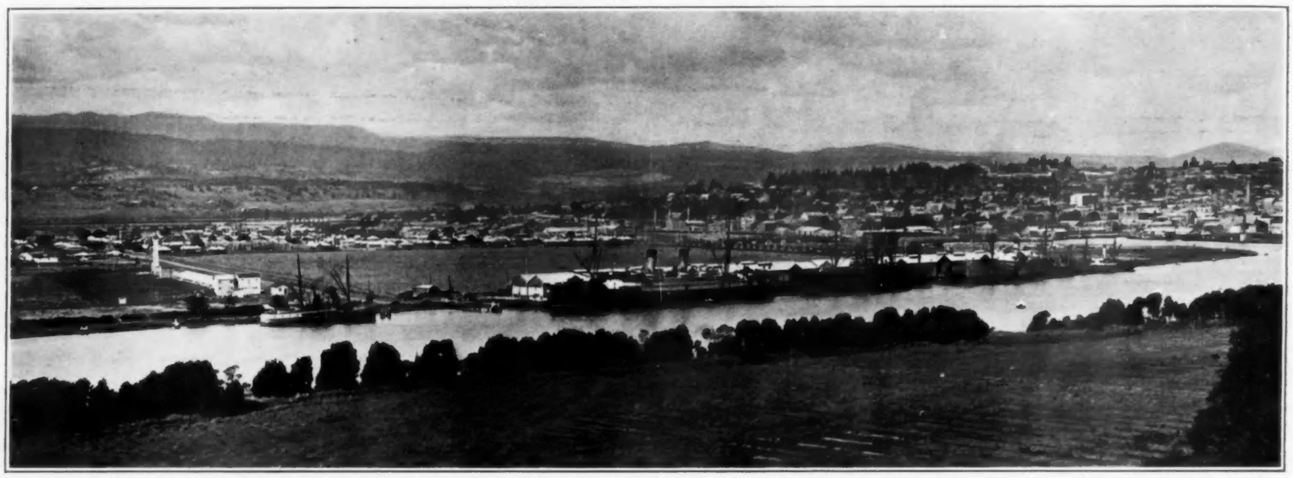
Capital Expenditures

Expenditures on fixed assets charged to capital in 1938 amounted to $1,549,756. In addition, the sum of $353,004 was expended on replacement of physical assets at Vancouver and Montreal chargeable to replacement reserve, making a total outlay of $1,902,760.

The Report is signed by R. O. Campney, Chairman; A. E. Dubuc, Vice-Chairman and Chief Engineer; and B. J. Roberts, Member.

The Marine Board of Launceston and the Port of Launceston, Tasmania

By GEORGE S. MEREDITH, Secretary of the Board



Section of the Wharves and view of the City of Launceston (40 miles from Heads)

BY way of geographical description, it may be said that Tasmania appears on the map as a heart-shaped island hanging from the south-east corner of the Australian Continent. It is often called "The Garden Island State," chiefly on account of its wonderful scenery.

Location and Environment

The City of Launceston, with its thirty thousand inhabitants, is situated at the head of the magnificent Estuary of the River Tamar, which has a total length of 41 nautical miles from Town Point, where it is formed by the junction of the North Esk and South Esk River, to Low Head, where it enters Bass Strait.

Both navigationally and scenically, the Tamar occupies an important place in the long list of the World's Estuaries. High hills flank it nearly all the way, clothed in native forest verdure, or adorned by cultivated fields and orchard land, and culminate by providing a conspicuous and picturesque setting for the City of Launceston at the terminus, with its mountain background.

Launceston is the terminus of the principal Steamship Lines operating between Tasmania and the mainland of Australia. Melbourne, the second City of Australasia, is within 18 hours' steam of Launceston. The entrance of the Tamar is about midway on the sea journey between Adelaide and Sydney, or Perth and Brisbane. Thus Launceston is ideally situated as a distributing centre for the whole of Australasia.

Agricultural produce, Fruit (principally apples), Minerals, Timber, Wool and Woollen Goods are the principal exports of the port, and imports consist largely of manufactured articles and general merchandise. The port also enjoys a very large passenger traffic, particularly in the summer months, when Launceston is visited by tourists from the mainland and elsewhere. The city itself is of industrial importance; amongst some of the largest established undertakings are branches of the well-known English manufacturers, Messrs. Paton's & Baldwin's Ltd., and Kelsall & Kemp, Ltd. Its potentialities are such as to provide valuable scope for the enterprise of industrial pioneers.

The "Tamar" also has historic interest, for on the 3rd November, 1798, that intrepid navigator and explorer, Matthew Flinders, accompanied by the no less dauntless spirit, George Bass, in the sloop "Norfolk," coasting along the northern shore of Tasmania, then Van Diemen's Land, saw with great interest, indications of an opening in the land, and rounding a low head, entered a broad inlet. Sailing up the inlet three miles, they passed a low green island, and helped by the waters of a strong flood tide, they swept rapidly onward till the harbour suddenly expanded into a broad and beautiful basin. There appeared to be three rivers or arms discharging themselves into the basin, and the sloop was brought to anchor near the mouth of the western arm. Flinders was greatly pleased with his discovery, and spent 16 days examining the locality. He explored the western and middle arms and penetrated up the main stream as far as Shoal Point (now Nelson's Shoals); then, although he believed half the river was yet unexplored, the limited time at his disposal caused him to return to Low Head, to which he gave the name. Strange to say, he did not give the river any title, but Governor Hunter, of New South Wales, named it Port Dalrymple, as a compliment to Alexander Dalrymple, the well-known hydrographer of the Admiralty. The upper reaches of the river were first explored by William Collins in the "Lady Nelson," who entered Port Dalrymple on New Year's Day, 1804. The vessel was anchored at Upper Island (now Tamar Island), and the examination of the yet unvisited portions of the river was made in a boat.

On the 4th November, 1804, Lieut.-Colonel Wm. Paterson arrived in Port Dalrymple with his expedition to found the new colony. At first, he landed at Outer Cove (now George Town), and notwithstanding the fact that, in the meantime, he had himself explored and proved the suitableness of a settlement at the junction of the two rivers, which he named the South Esk and the Tamar (the latter out of compliment to Governor King of New South Wales, whose birthplace was on the Tamar in England), and this included the lower reaches of that now known as the North Esk, he, later on, decided to make his permanent settlement at the head of the Western Arm. Here he founded York Town, but after giving the locality a trial

Portion of the River Tamar, 30 miles inland.
Also view of the T.S. "Nairana," an Inter-state Passenger Steamer of 3,042 tons

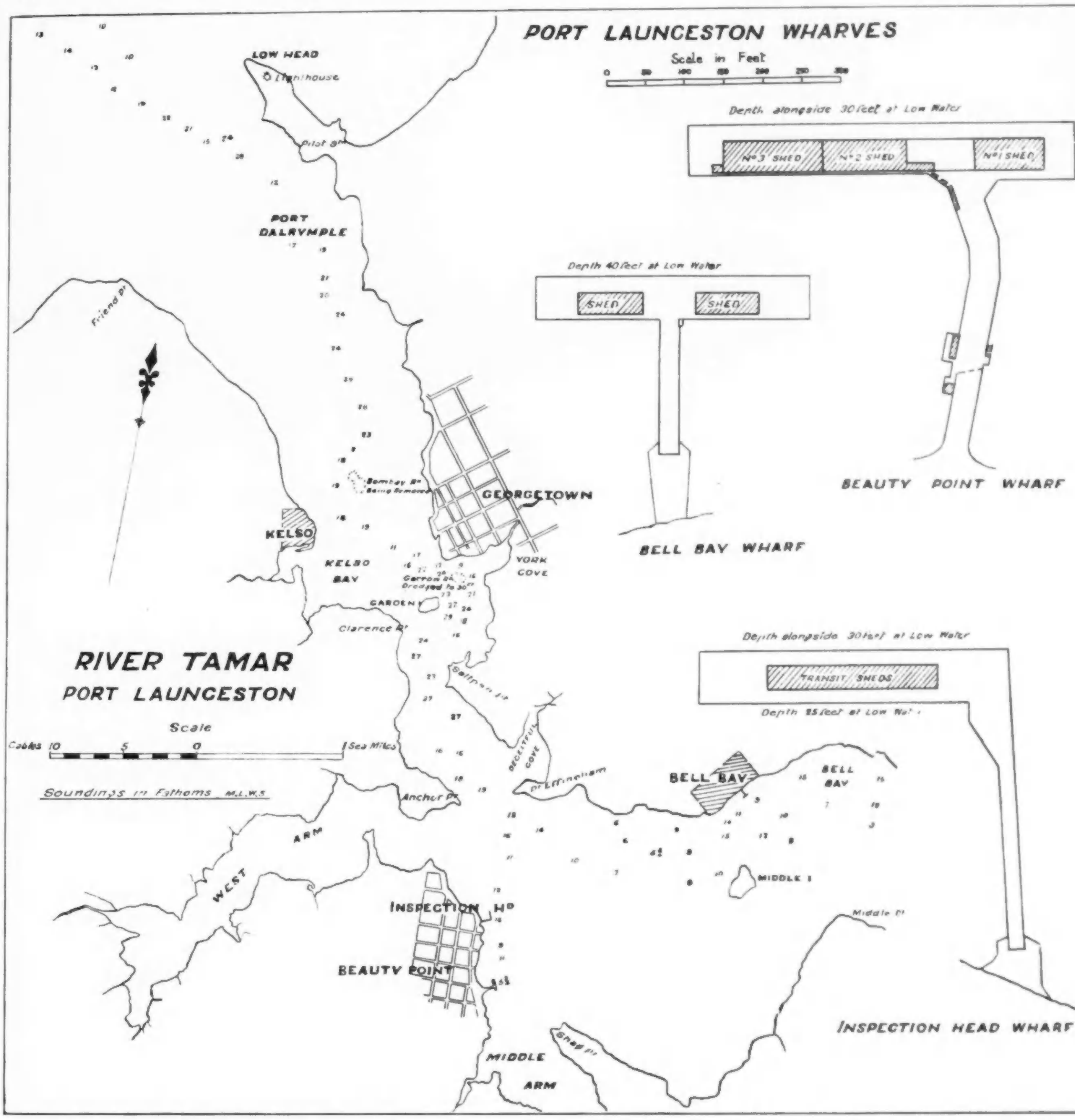
Marine Board of Launceston and Port of Launceston—continued

for some months, he removed his headquarters to the present site of the City of Launceston, naturally so named from its position on the River Tamar.

Since the foundation of the settlement at Launceston by Paterson in 1806, the growth of the port has been steadily increasing. For many years the control of the river was solely in the hands of the Government officials till the formation of the Marine Board of Launceston in 1858.

It should here be mentioned that, after exactly ten years' trial, the Board's jurisdiction limits were altered by an Act and Proclamation, which formed separate jurisdictions for the Mersey, Table Cape, and Circular Head Marine Boards, leaving the Launceston Board with its present jurisdiction, viz., from Cape Portland to Badger Head.

Between 1858 and 1921, the constitution of the Board was altered on many occasions and, at the present time, it consists



The Marine Board

The Marine Board of Launceston was constituted under the Act (Tasmania) 21 Vic. No. 16 (December 22nd, 1857), which provided for the establishment at Launceston of a Guild, to be called the "Marine Board of Launceston," having for its objects the general control and management of the Ports, Harbours, Wharves, Docks, Pilots, and other matter relating to the navigation and shipping. The limits of the jurisdiction of the said Board were defined as extending to all ports, harbours and islands on the Western and North-Western Coasts between the 42nd Parallel of south latitude (Henty River and Cape Portland).

The Board was to consist of five wardens, being the Mayor of Launceston, the Collector of Customs at Launceston (both ex-officers), and three other persons to be appointed by the Governor-in-Council; the Launceston Chamber of Commerce, however, had the privilege of nominating these three members.

The Board was not actually formed until early in 1858, the first meeting being held on February 19th of that year, when there were present the Mayor (Mr. Henry Dowling), the Collector of Customs (Mr. Burnett), and Messrs. G. Gilmore, R. Green and A. McNaughton.

of five Wardens elected by the City of Launceston, each Warden being elected for a term of three years.

The first Harbour-master was Capt. W. Ling, who was followed by Captains W. R. Barwood, J. J. Bradley, W. A. Clark, and the present Harbour-master Captain J. T. Reid was appointed in 1934.

The Secretaryship was first held by Mr. A. J. Marriott and by Mr. G. M. Eddie, from 1863 to 1884, Mr. A. E. Evershed from 1884 to 1912, when the present Secretary (Mr. Geo. S. Meredith) was appointed.

The great increases in the size and draught of vessels which has taken place during the past few years has directed special attention to the capabilities and limitations of the chief ports in Australia. In this connection, a few facts set out briefly regarding the Port of Launceston and its navigation should be interesting.

The Entrance to the Port

There is no bar or obstruction to the entrance of the Tamar. The main channel has a depth of 10 to 22 fathoms at low water, and is 900-ft. wide at its narrowest part to Lagoon Bay. Here there is good anchorage for vessels of 400-ft. in length, with room to swing in nine fathoms of water. The river takes a

Marine Board of Launceston and Port of Launceston—continued

southerly course from here to Kelso Bay and Bombay Rock. The curves are easy with a wide radius, channel ranging from 800 to 1,200-ft. in width, and has a depth of from 17 to 29 fathoms. The channel trends from here to the East South East, the curve around Bombay Rock, having a radius of 1,800-ft. through 57° change of arc. The same width and depth are maintained to Garden Island. Rounding the Island, the channel turns to the South West, having a radius of 1,200-ft. through 60° change of arc to Saltpan Point. The channel then continues in a South Easterly direction to Point Effingham, and then Easterly to Long Reach, a beautiful stretch of water one mile long by 2,000 to 3,000-ft. wide, with least depth of eight fathoms. It is here that the Bell Hay Wharf has been constructed. The wharf is 350-ft. long by 50-ft. wide, with substantial dolphins spaced 200-ft. apart from each end of the structure. The minimum depth alongside is 40-ft. at standard low water. Large transit sheds are provided; also an ample supply of fresh water is available. Owing to the open waters opposite the wharf, steamers of extreme length and size can both approach and leave the wharf with the greatest of ease under their own power.

Beauty Point

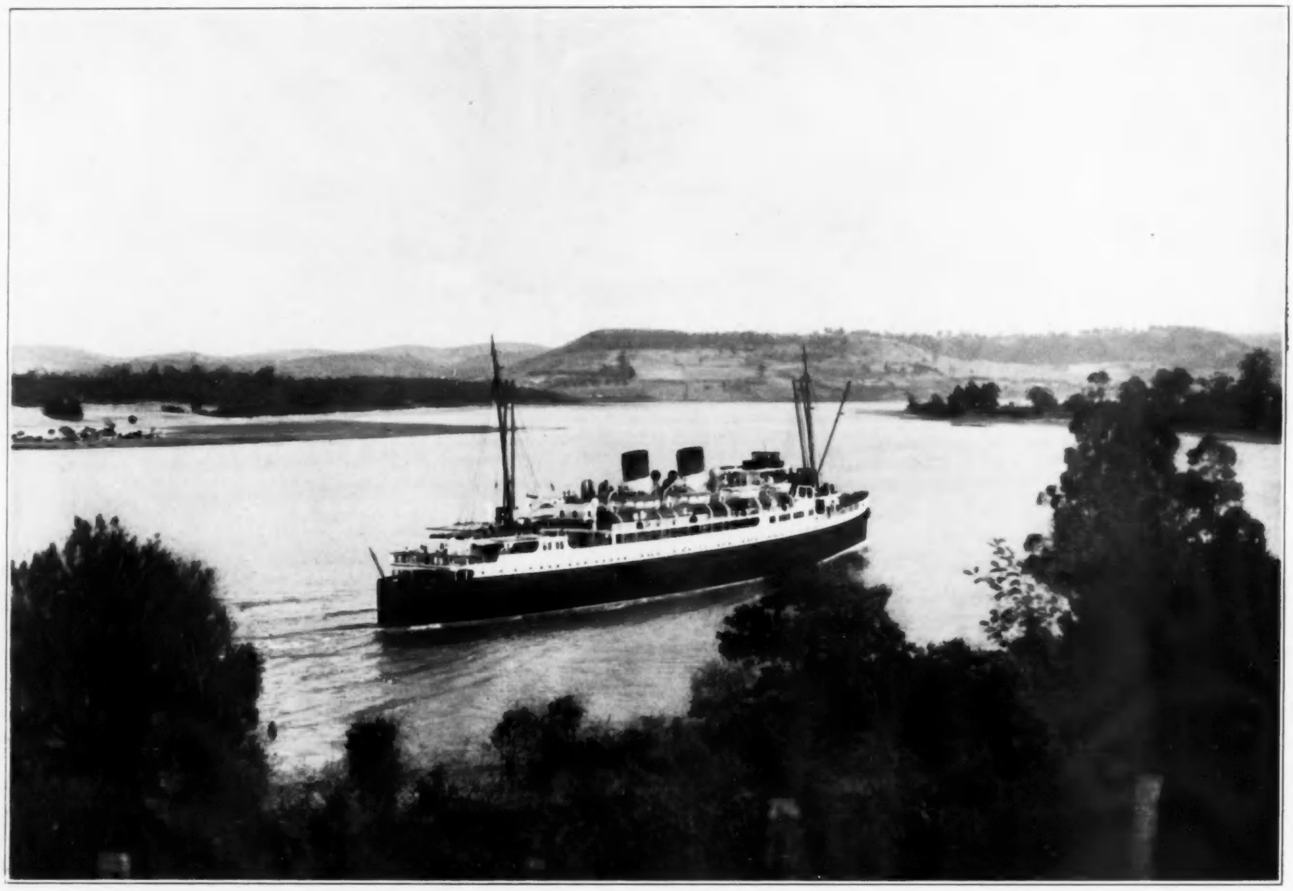
Beauty Point is a deep-water harbour, situated six miles from entrance, easy of approach, and safe in all weathers. There is a wharf 500-ft. long, with strong mooring dolphins head and stern. Vessels, 525-ft. in length with a draught of 30-ft. at high water, and 515-ft. in length with a draught of 24-ft. at low water, can swing and safely moor, there being a depth of 30-ft. alongside at low water. Vessels exceeding the above lengths require the assistance of a tug to swing. Shed accommodation extends for the full length of wharf, capable of housing 50,000 cases of fruit. Cool stores of the same capacity are constructed adjacent to the wharf. Beauty Point is served with electric light and telephone system, and there are good road connections to Launceston.

Inspection Head

To meet the increased demands for berthing accommodation in the lower reaches, the construction of a new wharf at Inspection Head, about ¼ mile north of the present Beauty Point Wharf, has just been completed. The particulars of this wharf are as follows:—Length 400-ft., width 62-ft. 6-in., depth alongside outer berth standard low water 30-ft., inner berth 20-ft. Substantial mooring dolphins have been driven 150-ft. south end, 100-ft. north, giving a spread of 650-ft. between dolphins. There is swinging room abreast of wharf at low water 1,200-ft., and at high water 1,500-ft., with at least depth of 30-ft.

It is at these deep-water ports that the bulk of the port's oversea trade is dealt with, the general cargo in most instances being lightered from and to Launceston in steel barges, maintained by the Port Authorities.

At Launceston (41 miles from Heads) wharfage is available for a length of 3,000-ft., with a depth of water alongside at high water of from 22-ft. to 28-ft., the bottom being soft mud. The range of tide is from 10-ft. to 12-ft. All wharves are equipped with transit sheds. A length of 1,300-ft. of the main wharves is connected up with the State Railway Service. The whole of the river, from Heads to Launceston, is well buoyed and lighted. A powerful sea-going tug-boat is maintained by the Port Authorities; also a small floating dock is available.



T.S. "Taroona," 4,286 tons, Outward Bound, passing Dilston, 32 miles from Entrance to Port of Launceston

It will be seen from the following statistics that the trade of the port is being well maintained.

VALUE OF IMPORTS AND EXPORTS TRADE FOR FINANCIAL YEARS 1932-1937

	1932-1933	1933-1934	1934-1935	1935-1936	1936-1937
Imports	2,336,427	2,726,718	2,806,538	3,370,138	3,495,274
Exports	1,838,341	2,016,704	2,275,813	2,588,870	2,676,895

SHIPPING

Number and Nett Tonnage of Vessels entering the Port

1932-1933	1933-1934	1934-1935	1935-1936	1936-1937
457—410,197	487—401,047	467—393,487	473—490,665	456—499,527

Revenue of Port

1932-1933	1933-1934	1934-1935	1935-1936	1936-1937
£49,325	£56,284	£62,592	£66,269	£58,321

Harbour Improvements

Several schemes have been considered by the Marine Board of Launceston, from time to time, for the improvement of the river and harbour, but no definite line of action was laid down for future work in this respect until the year 1911, when the Board decided to consult the late Mr. Henry Hunter, M.I.C.E., of Manchester, England, who accordingly visited Tasmania, and after making a study of the river and local conditions and requirements, presented to the Board his report for the improvements of the upper and lower reaches of the river. The report was adopted and approved; the consent of the ratepayers concerned was obtained and the necessary Parliamentary Sanction secured. An Act of Parliament (the Tamar Improvement Scheme, 1913) was passed, empowering the Board to borrow up to £400,000 and carry out the work.

Owing to the outbreak of the war in 1914, the major works in the lower reaches were postponed. The Board being content

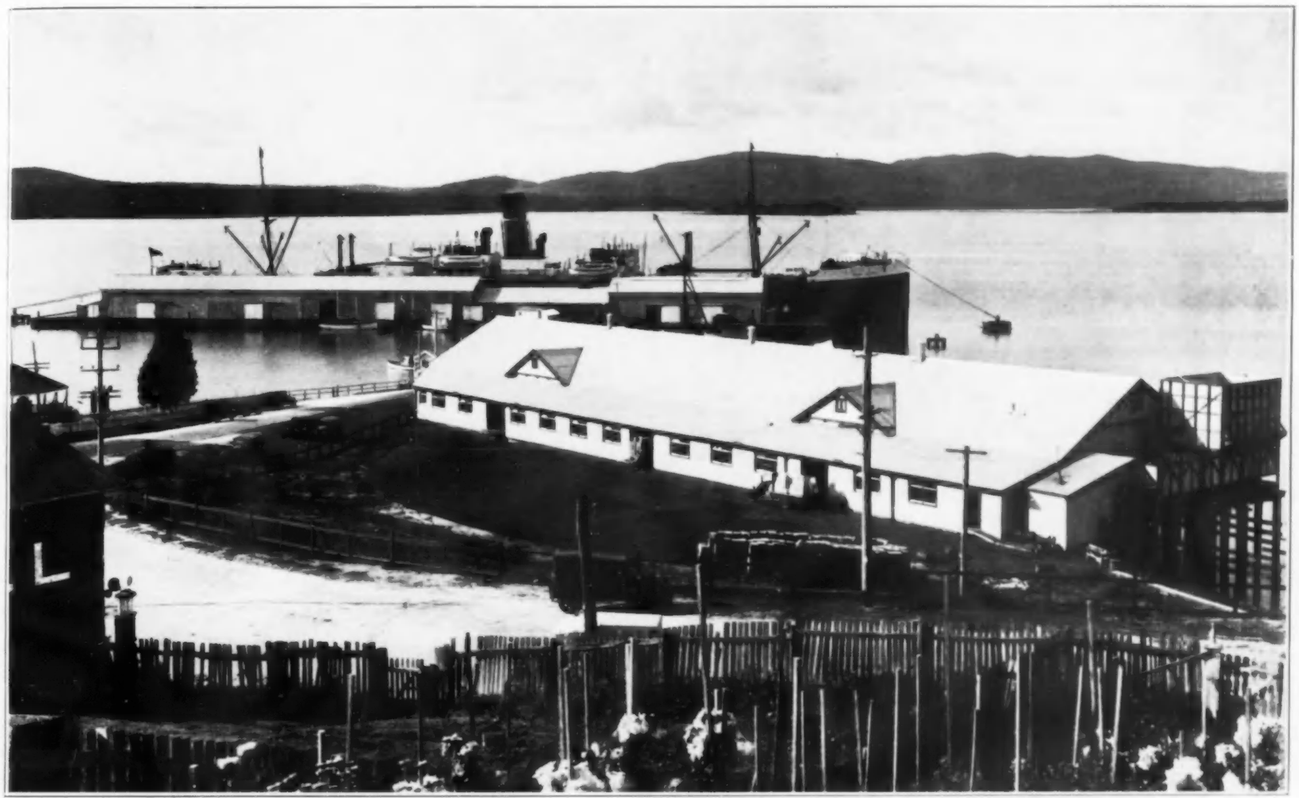
Marine Board of Launceston and Port of Launceston—continued

to concentrate on the improvements of the upper reaches by dredging operations.

The Marine Board have, since the inauguration of the Tamar Improvement Scheme, expended in Channel formation, Channel maintenance and rock removal operations, an amount of over £350,000. Of this amount, £276,000 has been spent in the upper reaches between Rosevears and King's Wharf, a distance of approximately 12 miles, while £80,000 odd has been expended in the lower reaches between Low Head and Effingham Light, a matter of six miles.

The other two obstructions, "Toroa" and "Auckland Patch," were removed, at a cost of £6,800 and £5,400 respectively, the quantity of material dredged being 10,500 cu. yds. and 16,400 cu. yds.

With the removal of the above obstructions, the navigability of the river has so greatly improved that it is now possible to work vessels of a tonnage of 20,000 tons gross and upwards of 600-ft. in length into and out of the deep-water ports at Bell Bay and Beauty Point during the slack periods of the tide, and vessels of normal size at almost any state of the tide.



S.S. "Port Sydney" at Beauty Point—Port of Launceston

The work carried out in the lower reaches consisted of removing certain rock obstructions, known as the "Porpoise Rock," "Garrow Rock," Toroa Bank," and the "Auckland Patch."

The nature of these rocks is mainly a mass of basaltic boulders and shingle closely set together, the material hardening continually to the centre.

All the above-mentioned obstructions have been dredged to a depth of 30-ft. at low water, the working being carried out by the dredger "Ponrabbel II." This dredger was built by Messrs. Ferguson Bros., Port Glasgow; it is a ladder dredger with a chain of 34 buckets, each of a capacity of 12 cu. ft. The buckets are specially constructed to treat with rock material.

The first rock removed was the "Porpoise," the size of which at the 30-ft. contour was 1-1/6 acre, 24,000 cu. yds. of rock being dredged and dumped at a cost of £27,000.

The next work dealt with was the "Garrow." This necessitated the removing of 97,000 cu. yds. at a cost of £31,000. The size of this rock at the 30-ft. contour was 4¼ acres. At standard low water the extreme measurements of the rock uncovered were 220-ft. by 100-ft. by 6-ft. in height. Dredging was taken in "steps," to the following depths: 12-ft., 16-ft., 20-ft., and 30-ft. Amongst the material dredged, there were 19,784 boulders, the weight of which ranged from 5 to 25 cwts., each of which had to be lifted by hand crane from the dredge buckets on to the barge tables receiving the dredged spoil. All dredged material was dumped in the deep water surrounding the rock.

This work being of some magnitude, the following analysis of the dredging time may be of interest:—

	Hrs.	Mins.	Percentage
Dredging	3,541	45	49.20
Waiting for barges	628	15	8.73
Moorings	282	45	3.93
Digging buckets	3		.04
Coaling		35	.01
Traffic	12	35	.18
Repairs	1,446	30	20.10
Weather delays	70	20	.98
Slinging boulders	766	15	10.65
Mooring dredge	255	45	3.55
General	189	30	2.63
Totals	7,197	15	100.00

With a view of making the port available to the largest ships trading to Australia, the Board has commenced with the removal of the obstruction known as the "Bombay Rock." The area of this rock on the 30-ft. contour is 9¼ acres, and the materials to be removed is estimated at 113,000 cu. yds. It is expected that the work will take from two to three years to complete, and will cost approximately £39,500.

Manchester Ship Canal

The approximate traffic receipts of the Manchester Ship Canal for the month of March, 1939, amounted to £111,841, compared with £111,300 for March, 1938. The aggregate receipts for the three months, January to March, 1939, were £302,409, an increase of £1,813, compared with the corresponding period of last year.

New Port of Assab in Italian East Africa

The "Giornale d'Italia" of the 19th March contains an article on the new Red Sea Port of Assab in Italian East Africa. The work of building the harbour at this port was begun in January, 1938, and it is expected that it will be substantially completed by April, 1941, at which time there are to be available for use 1,200 metres of wharves with a depth of water from 9 to 10 metres, and in addition about 700 metres of quays suitable for small vessels. Sheds and cranes will also be provided, and the port will be linked to the capital by a road passing through Dessié which, it is expected, will be completed by November of this year.

In the meantime, a considerable amount of trade is already being carried on at this port, notably the export of salt which is produced in the neighbourhood. Official statistics covering the first nine months of 1938—the latest available—show Assab as the busiest port, after Massawa, in the whole of Italian East Africa, both as regards number of ships and net tonnage entered and cleared, quantity of goods discharged and loaded, and number of passengers landed and embarked. It is, of course, possible that a portion of the goods discharged were materials used in the construction of the harbour, but no evidence bearing on this point is available.

Salvage of a Dredger at Port of Havre

An Unusual and Difficult Feat

The following account of the successful salvage of a dredger which foundered recently at the Port of Havre, is reproduced, together with the illustrations, by kind permission, from the December 1938 issue of "The Shipping Register and North American Ports."

The dredger in question, "No. 5," property of the Havre Port Authority, capsized and sank during a severe storm several months ago while lying at a quay in the tidal basin.

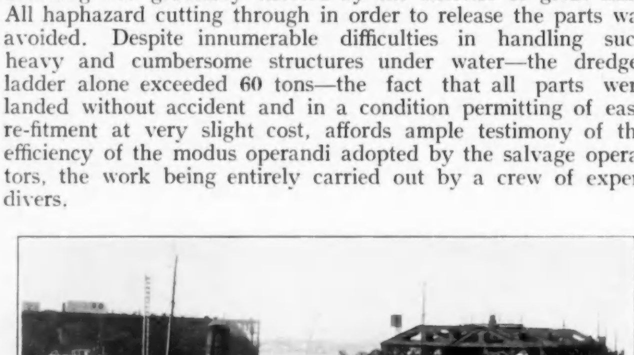
A diver's inspection showed the wreck to be lying on her starboard side, deeply embedded, her upper structures being completely buried in the mud and pointing downwards towards the floor of the basin. It was necessary first to upright the dredger before any lifting operations could be commenced, and it was decided to excavate a trench along the port side of the wreck, for a length of approximately 300-ft. by 100-ft. in width, and to a depth of about 10-ft. The object was to manœuvre the sunken vessel into this prepared trench by means of steel wire cables fixed to the far side of the harbour.

The nearest place to secure these uprighting cables was fully three-quarters of a mile away, low lying, and the main channel into and out of the port had to be crossed in order to reach it.

The uprighting plan consisted in rigging five double cross-channel cables from the shore end, attached to slings and parbuckles passing round the dredger, the whole being operated from a floating platform with five 15-ton capstans, by means of which a haulage power of over 900 tons could be exerted; in addition, a lifting pontoon was brought into use, the chains of which were shackled to the tower and upper structures of the dredger. These dispositions were successful, and the dredger was finally hauled into an upright position.

The lifting scheme was as follows:—the estimated weight of the dredger, plus suction and mud in the interior, was 1,200 tons; the lifting pontoon consisted of two hulls, on which was erected a massive overhead superstructure operating six pairs of lifting chains of 700 tons capacity; by augmenting the lifting equipment to 1,000 tons, this could be made equal to the buoyancy capacity of the pontoon. To reduce the weight, it was therefore necessary to dismantle various parts of the dredger, notably the dredging ladder, gear wheels, dredging buckets, etc.

The position of the dredger, exposed to strong tidal currents, did not facilitate this part of the work. Nevertheless, the dismantling was gradually effected by the exercise of great skill. All haphazard cutting through in order to release the parts was avoided. Despite innumerable difficulties in handling such heavy and cumbersome structures under water—the dredger ladder alone exceeded 60 tons—the fact that all parts were landed without accident and in a condition permitting of easy re-fitment at very slight cost, affords ample testimony of the efficiency of the modus operandi adopted by the salvage operators, the work being entirely carried out by a crew of expert divers.



Transfer of Dredger to Graving Dock

The removal of the upper structures and the dislodgment of huge quantities of mud from the wells and inner compartments, with the consequent reduction in the weight to be lifted, terminated what may be described as the first stage of the salvage.

The subsequent and final phase, namely, the actual raising of the dredger, constituted possibly the most difficult part of the whole undertaking.

The lifting pontoon was securely moored in position exactly over the wreck, after which 6-in. steel cables were shackled to the lifting chains, regulated as the tide fell, and finally secured.

At low tide, everything was in position and the whole firmly harnessed. Under the influence of the rising tide, the pontoon began to take the load and, happily, all wires held. Thereupon it was decided to continue the operation and float the wreck. After an interval of 2½ hours, the pontoon, with its heavy load in suspension, began to rise steadily. The combined pontoon and dredger showed a total draft of 48-ft. 4-in.

The progress during transfer of the dredger to the graving dock—a mile distant—on a flood tide and through dock gates, was necessarily slow, and called for extreme care and expert manœuvring on the part of the three Abeilles tugs entrusted with this delicate operation.

Salvaged Dredger in Graving Dock

The journey was, however, effected without the slightest mishap. The lifting pontoon was accompanied by the ferry steamer "Adolphe Prince," attached to her starboard side. This vessel had been engaged to supply the auxiliary power for the dock's engines during the raising operation. The two vessels measured a total width of 117-ft., and as the entrance to the dock did not exceed 123-ft. 6-in., there was only a narrow margin of 3-ft. on each side between the convoy and the graving dock entrance. The tugs, however, manœuvred successfully, and the entry was safely, if slowly, negotiated.

The dredger was gradually lowered, and finally released on to the cradle specially prepared on the floor of the graving dock.

The total number of men taking part in the salvage was 160, including a squad of expert divers. The length of the steel hawsers, of varying dimensions, used in the operations, reached a total of nine miles, and weighed over 70 tons.

The whole operation was carried out by the Abeilles Salvage Company for the Salvage Association.

The Harbours of the Isle of Man

(concluded from page 192)

area of approximately 20 acres, providing accommodation for vessels up to 2,000 tons gross register.

The entrance, which has an easterly aspect, is formed on the south side by a masonry pier, 700-ft. long, and on the north side by a timber breakwater, 700-ft. long. The latter, built in 1855, is an excellent example of Abernethy's work.

Remote from the harbour, some 600 yds. southward, the Harbour Commissioners maintain an iron pier—The Queen's Pier—which extends from the promenade seaward for a distance of 2,300-ft. At the seaward end of the pier there is a depth of 18-ft. of water at L.W.O.S.T., and berthing facilities are provided for passenger vessels. The pier is equipped with a tramway (petrol, loco. and cars) which runs throughout the season.

The passenger landings at the Queen's Pier have fallen from 10,737 in the year 1913 to 5,066 in the year 1938, but this is by no means indicative of the decline of Ramsey as a holiday resort, for the decrease in "direct landings" is entirely due to the recent revolutionary increase in the Island's internal transport which, by virtue of its present speed and comfort, influences the flow of travel via Douglas Harbour where, as previously indicated, very frequent, regular speedy and comfortable sea travel is available.

Improvements at the Royal Docks, Port of London Authority*

By RALPH ROBSON LIDDELL, M.Inst.C.E.

Discussion

The Chairman, in proposing a vote of thanks to the Author for his Paper, remarked that it contained a very valuable record of historical work, and also a great wealth of detail. Records of that kind relating to work which had been done so recently were of great value.

Mr. Asa Binns remarked that the works might be generally described as improvements rather than as extensions. The docks of the Port of London Authority dated back to the end of the 18th century, and it was not surprising that of the £20,000,000 spent in capital improvements since 1909, a substantial proportion had been spent in improvements to the old docks calculated to fit them for meeting modern traffic requirements, rather than upon extensions or the development of new sites. When the extraordinary growth in the size of shipping was considered, it was perhaps surprising that the layout of the old docks was such that they could be improved to deal with modern needs.

The provision of a false quay at the Royal Albert Dock, with a sloping bottom dredged out to the extra depth necessary, was quite a common form of construction. It was cheap and efficient, and excellent so long as the wall was on a foundation which would stand up to the slope of the new bottom. There was no doubt about that in the case in question, because there was a ballast bottom. One objectionable feature of the scheme was that it narrowed the dock by 20-ft.; the Albert Dock was very busy, and at times there was congestion of water-borne traffic, so that if ever the south quay were dealt with in the same way the effect would be still more objectionable in increasing that congestion.

The work could have been carried out in easy stages, by starting at one end, with the minimum of disturbance. Various alternatives had been considered, but ultimately it had been decided to carry out the work very quickly, working from both ends; that had caused quite a considerable outcry from the shipping interests at times.

When the work of deepening the Connaught Road passage had been started, it had been hoped that divers would be able to peel off the brick courses one after another with pneumatic hammers and drills. That, however, had proved to be impossible, and the mortar, being quite as strong as the brickwork, came up in fragments, which made the work all the more difficult in view of the danger of a break-through. A break-through would have meant the flooding of the tunnels, of Silvertown, and of East Ham, and the putting aground of the whole of the shipping in all three of the Royal Docks, and the greatest care was necessary in carrying out the work in order to avoid such a catastrophe. With the diving bell reliance had not been placed merely on lowering the bell through the 30-ft. of water; it was connected to the air-supply at the dry dock, and they blew the bell out so that the men who were working were only ankle-deep in water when cutting out the brickwork.

A few words might be said about the Victoria Dock, which had given a lot of trouble and was most unsatisfactory. The entrance lock had collapsed before the dock was opened, the quays had never been fit for carrying the traffic—at least for the 30 years with which he had been associated with the dock—and in various sections they had collapsed, and had been stiffened with sheet-piling. A word might be said about the curious Pontoon Dock, which had not been constructed by the Victoria Dock Company but by a graving-dock company, who intended to repair vessels in the narrow bays provided. The vessels were lifted by hydraulic rams, put on to pontoons, and taken into the bays for repair.†

After the Silvertown explosion, Sir Cyril Kirkpatrick, Past-President Inst. C.E., had laid down roads and railways and had built two first-rate sheds, Nos. 2 and 3. Later on, when the Ministry of Transport had carried out their scheme for the Silvertown Way, which had so improved access to the whole area, the Port Authority had agreed to the bridge crossing the western entrance being a fixed bridge at a sufficient height to clear barge traffic. After that had been agreed upon, they had taken in hand the complete repair of that entrance lock by putting a new invert in it in the dry, with a sufficient depth to take barge traffic; all shipping using the whole of the three docks had now to be locked at the Gallions entrance, where there were three excellent locks.

He would like to put in a general plea for the improvement of shipping berths. It was astonishing to find magnificent ships needing deep-water approaches, expensive dredging and entrance locks, quay walls, and so on, being dealt with at berths with uneven paving, inadequate cranes, bad lighting, and bad ventilation. It was no wonder that there was carelessness in the handling of goods.

So far as the wall in monolith construction was concerned, there was the usual trouble with obstructions. The monoliths were originally designed to be constructed in block-work in 2-ft. 6-in. courses. The contractors asked to be allowed to build them in mass-work, and after making inquiries and discussing the matter, it was agreed that they should be built in mass-work, and he believed that it had made a better job. The north quay was not yet completed. It would make a magnificent quay with five berths, and Mr. W. P. Shepherd Barron, M. Inst. C.E., his successor as Chief Engineer of the Port of London Authority, had already placed a contract for the five new sheds, which would be similar to No. 1 shed but wider and longer. No doubt, later on, Mr. Shepherd Barron would equip the Mudfield quays equally well, and when the whole of the works were completed the group of docks, with their wonderful situation so close to the City of London and with the deep water available, and with the fine road and railway access, would continue to maintain their supremacy, at any rate in the Port of London, for the handling of ships' cargoes.

In conclusion, he would like to say a word of thanks to the engineering staff, whose constant care was necessary in the carrying out of the works and in their design. All concerned had worked most loyally, and he appreciated their services most highly. The Port of London Authority were privileged in being able to secure the services of public-works contractors who had had long experience in carrying out works of the character in question, and for such works it was necessary to acquire a technique which nothing but experience could give; he would like to pay a special tribute to the professional and working staffs of those contractors.

Sir Cyril Kirkpatrick, Past-President, said that the work which had been described was really the 1910 scheme of the late Sir Frederick Palmer, Past-President Inst. C.E., with important additions and amplifications. One outstanding alteration and addition was the new tunnels inserted in the old brick tunnels, and the deepening of the Connaught Road passage. That was not in Sir Frederick Palmer's scheme, and during his own time as Chief Engineer it had not been seriously contemplated. He believed that he was right in giving to Mr. Binns the sole credit for taking that step and for advising that the tunnel should be strengthened and the passage deepened.

The two railway approaches, north and south, were at marsh-level. Mr. Binns had referred to the possibility of flooding Silvertown; he had had some experience of flooding when the King George V Dock was being constructed, because a "blow" had occurred on the south side. They had previously had to make a long ditch for the Commissioners, and the blow just equalled the capacity of the ditch, so that they were able in every tide to get rid of all the water which collected. That was a fortunate circumstance, but the incident gave him an insight into what might happen, and he wondered what would occur if it had increased and it had not been found possible to stop it.

It was stated in the Paper that the deepening of the passage at Connaught Road had cost £70,000. Sir Frederick Palmer's scheme had been to make a new entrance at the Victoria Dock, which would probably have cost 10 times that sum. He thought it would be agreed that the method which had been adopted of dealing with all the traffic from the down-river end instead of any shipping coming in at the west end, was much more satisfactory.

The Author referred to the pumping station at the east end of the docks. When that had been under consideration, Sir Cyril had asked Mr. C. E. Lefroy, Assoc. M. Inst.C.E., to carry out some experiments and tests to find out what was really the most economical time for pumping, having regard to the state of the tide and the amount of silt in the water. From the notes made at the time, it appeared that the average silt-content to a depth of 15-ft. at two hours before high water was 0.46 gramme per litre, whilst at two hours after high water it was 0.09 gramme per litre. That showed fairly clearly that if the pumping could be done on the ebb tide it would be much more economical from the point of view of dredging than if it were done on the flood tide, but it was found that to do so would involve so much increased cost for electricity that the idea had to be abandoned, and an equal time of three hours on each side of high water was adopted as being the most economical in the circumstances.

Sir Henry Japp congratulated Mr. Asa Binns on his adoption of the false-quay system, which enabled the dock wall to be preserved while giving deep enough water for modern ships. The Port of London Authority, by adopting that scheme, had been enabled to modernise the Royal Docks and to improve them so greatly that it looked as though the big dock, which all con-

*Paper read before the Institution of Civil Engineers, November 29th, 1938. Reproduced from the Institution Journal by kind permission of the Council.

†E. Clark, "The Hydraulic Lift Graving Dock." Minutes of Proceedings Inst. C.E., vol. xxv (1865-66), p. 292.

Improvements at the Royal Docks, Port of London Authority—continued

tractors had been hoping for, on the north side of the Albert Dock, would not be the subject of tenders for a long time. It was said that the need for protective tariffs had so reduced the mercantile marine that it would be many years before that dock was built.

The first time that he had had experience of a false quay was when he had carried out some work on modernising the old Lonsdale Dock at Workington to the design of the late Sir Frederick Palmer. Sir Frederick had made those false quays with reinforced concrete piles and very expensive horizontal and diagonal bracing. Mr. Binns, by adopting cylinders to stiffen the piles, had been able to avoid that expensive work of bracing and had secured an equally good result. Sir Henry's first experience of the use of reinforced-concrete cylinders with piles in that way was in connection with the work of the late Mr. H. A. Reed on the Manchester Ship Canal, where instead of using reinforced-concrete piles very strong steel cruciform piles were driven inside the cylinder, and a longitudinal pre-cast girder, weighing 60 tons, was supported on the cylinders, the girder being hollow and forming the tunnel for a grain-conveyor.

The reinforced-concrete girders used in the works described by the Author were first of all built on the soffit forms, and after the lapse of the required time the shutters were removed, because it was impossible to get to them after the decking was built; the Author had therefore provided for trusses to be placed across the top of them and the weight of the girders to be carried by bolts from the trusses. The girders at that time contained the bottom tension bars, but none of the steel bars at the top for compression, as the girders were ultimately T-girders, the T part being in the decking. The nuts on the bolts were not tightened to any determined amount, and it therefore would be quite possible to lift the girders and to have them bend upwards to some slight extent, so that when the decking was fixed and the bolts were ultimately released there would be a greater deflexion than would ordinarily occur; in fact, they were bound to deflect until the steel came into play. That might result in more fractures of the soffits of the beams than was usual, but it would be impossible to see that because no one could get under the decking unless the water in the dock was lowered. A good deal had been heard about pre-stressing steel for use in reinforced concrete, but the question which he was discussing seemed to be rather one of de-stressing it.

It was impossible to get underneath the quay wall in the Victoria Dock after the front beam was built, because the water lapped the under side of it; the Author had used pre-cast girders for the longitudinal girders, and by putting rebates in the cross-girders he had been able to put a light pre-cast slab of reinforced concrete, 4-in. thick, to act as a shutter to carry the slab of the deck. By designing the work in that manner it was possible to get it done cheaply and quickly.

Mr. James Conacher remarked that, as a member of the staff of one of the contractors, he would like to make a few remarks about the Royal Albert Dock. He realised that a contractor was going to be a great nuisance to those conducting the working of the dock traffic, because the docks were very busy and it meant changing regular liners from their berths, and from the sheds adapted for their use. There was nothing else which could be done but to work for a speedy completion, and it had been possible to co-operate perfectly with Mr. Binns and with the Author to secure that end. Two plants had been employed, working from each end towards the middle, and they were able to complete as much as 360-ft. of quay per week in the later stages of the work.

Method of Suspension and structural details of Deck, North Side, Royal Victoria Dock

The works on the Mudfield site comprised an ordinary monolith quay wall. The monoliths were of excellent design, and the excavation was mostly in marsh clay " bungum," very much stiffer than the " bungum " which had been met with at Tilbury. At Tilbury the material used to flow to the grab, but at the Mudfield site that did not occur, and that was reflected in the amount of kentledge which had to be used on the Mudfield site as compared with the works at Tilbury. The monoliths at Tilbury, which were 25-ft. sq., could be put down with a maximum of about 400 tons of kentledge, whereas for the monoliths at the Mudfield site almost 800 tons were required. Curiously enough, when the gravel underlying the " bungum " at Mudfield was reached, it was possible to work with less kentledge. It was not necessary to de-water the monoliths at the Mudfield site, and in any case, since " bungum " was being dealt with, he did not think it would have been much use to do so, because the object of de-watering was to induce a flow round the base of the monolith so as to reduce skin-friction. It was rather difficult to estimate what the skin-friction on the monoliths was, but as nearly as could be estimated at Mudfield, it was between 8 and 9 cwt. per sq. ft.

Improvements at the Royal Docks, Port of London Authority—continued

Dr. Brysson Cunningham thanked the Author for giving such very full particulars of costs; in that connection he would like to congratulate Mr. Binns on having carried out the deepening of the north side quay in the Albert Dock at such a remarkably low rate as **£15.6** per lin. ft. Dr. Cunningham thought that the method employed was perhaps as cheap as any that could have been adopted, whilst it produced an excellent arrangement.

Sir Cyril Kirkpatrick and others had alluded to the original re-modelling scheme for the Royal Docks, put forward in **1910** by the late Sir Frederick Palmer while Chief Engineer to the Port of London Authority. Having held at that time the position of Personal Assistant to Mr. Palmer (as he then was), and therefore having taken part in the preparation of his scheme, which was shown in Fig. 22, it might be permissible for Dr. Cunningham to point out the more notable differences between it and the scheme actually carried out. On the north side of the Royal Victoria Dock, Sir Frederick had decided upon a straight quay, cutting right across the then existing jetties, but his line was not the same as that adopted by Mr. Binns, which lay farther south in continuation of the quay at "A" berth. On the south side of the dock, Sir Frederick Palmer's line came forward into the dock, leaving a distance between the two quays of **700**-ft., whereas, in the scheme carried out by Mr. Binns, the distance was only about **600**-ft., resulting in a reduction in width of about **100**-ft., which, in view of the traffic in the dock, Dr. Cunningham thought insufficient. Sir Frederick Palmer had made provision for deep-draughted vessels in the dock, allowing a depth of **38**-ft. **6**-ins., as compared with **31**-ft., and had contemplated an entrance for them from the west, with a large lock **700**-ft. long by **100**-ft. wide, having a sill **42**-ft. below Trinity High Water. Mr. Binns had seen fit to abandon altogether the idea of a ship entrance from the west, a step which did not commend itself to Dr. Cunningham, because vessels desirous of reaching berths at the extreme western end of the Royal Victoria Dock had now to travel the whole distance of **2½** miles from the eastern entrance through a narrow and often crowded waterway, and that was bound to involve difficult manœuvring. A condition peculiar to the docks of the Port of London was the great amount of cargo delivered overside into barges, and that fact had to be borne in mind, since the barges often incommoded the passage of vessels. While during ordinary routine operation the lack of an alternative entrance would prove inconvenient, the conditions in war-time had also to be considered. In the event of an air-raid warning, it would be an extremely difficult matter to clear the docks of shipping through a single entrance, and he doubted whether it could be done in time. On the north side of the Royal Albert Dock Sir Frederick's quay-extension width on each side was only **12**-ft. **6**-ins. instead of **20**-ft., so that there would have been less restriction of the waterway than with two widths of **20**-ft. now contemplated. The present width of the dock was about **470**-ft., and every foot was valuable. Sir Frederick had abandoned any idea of lowering the Connaught Road passage, and stated in his Report that he considered it to be impracticable; that opinion had been endorsed by Sir Cyril Kirkpatrick, but Mr. Binns had succeeded in securing an additional **3**-ft. in depth, for which he deserved hearty congratulations.

Mr. H. J. Deane remarked that reference had been made to the very difficult task which the maintenance of the Victoria Dock entrance had presented. There had been numerous attempts to stabilise the roller-paths for the lock gates by divers, by packing up with brickwork and concrete; one method which had been tried during the time that he had served with the Port of London Authority was very interesting. The great difficulty was to set on a bad foundation the cast iron or cast steel roller-paths and to maintain them more or less level to support a water-logged gate which weighed **95** tons. An attempt was made to overcome the difficulty by casting a trough section about **3**-ft. wide and **22**-in. deep in reinforced concrete, and setting inside the trough the cast-steel paths, which were only temporarily bedded down pending the placing of the troughs in the bottom of the lock. After the chase had been cut out by divers, the troughs had been lowered into position and carefully levelled and packed up with concrete; when the concrete had thoroughly set, the cast-steel roller-paths had then been placed in their proper position, and the entrance lock again set to work. It would be of interest to know the result of that method, and to know how long it had been really effective.

Sir Cyril Kirkpatrick had given some interesting figures with regard to the amount of silt, but had not suggested the great difficulty which arose in forming a proper estimate of the amount of pumping that the three large pumps at the Gallions locks would do. The length of quay was about nine miles (excluding the King George V Dock, which had not then been opened) and the total area of the docks was of the order of **8,000,000** sq. ft. The total newly-wetted surface was over **100,000** sq. ft., and to get a real test of the amount of rise in such a large area required particular care. When it was realised that one minute's pumping on that large area represented only **0.07**-in. difference in level, he suggested that those who were faced with that particular problem might consider the introduction of standing-wave flumes or venturi-meters.

The Author referred to the machining of the tunnel segments, and it would be interesting to know how that was carried out. He assumed that it was done in a planing machine, but he would like to know what the method was.

He fully appreciated the difficulties which were met with in the driving of the small pipe-tunnel, because in driving a number of tunnels in London clay similar difficulties had been encountered, and he had had a very great deal of trouble in doing some reclamation work by means of a suction-cutter dredger, when the only effective method for dealing with the septaria had been to drill holes and to crack them up by means of blasting.

Mr. F. M. G. Du-Plat-Taylor asked to what distance the deepening of the Albert Dock was carried out from the quay; was it carried half-way across the dock, or merely to a sufficient width to accommodate ships at the berth, and perhaps a vessel passing? The south quay was not deepened.

The cylinders shown in Fig. 20 for the Victoria Dock had three piles, and their dimensions were given, but the dimensions of the cylinders at the Albert Dock (Fig. 4) were not given. They appeared to be circular and to have only two piles.

He had been interested in the work at Mudfield. The material there, he believed, had been obtained from the hydraulic lift dock about **1860**, and it was not surprising that it was found unsuitable as filling. When he had been at the Victoria Dock in **1905**, it had been found to be quite unsuitable for carrying any load at all. An optimistic firm had rented the land with a view to making bricks out of the material, and they set up a good deal of plant and worked for about a year, but in the end they lost their money and left, because the bricks broke up in the kiln; after that, the site remained derelict until the scheme described in the Paper was carried out. He would be interested to know what was going to be done with the rest of the area. A

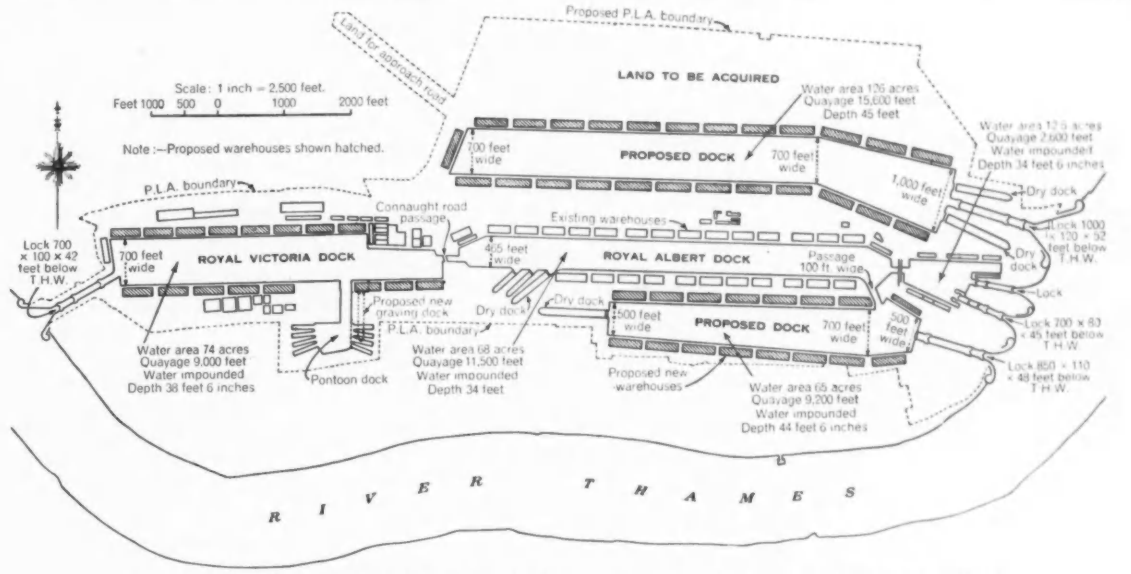


Fig. 22. The late Sir Frederick Palmer's Scheme for Remodelling the Royal Docks (1910)

Improvements at the Royal Docks, Port of London Authority—*continued*

large number of piles had been driven, apparently to carry a flour mill, and presumably the rest of the site would be covered with sheds, roads, and railway lines, but in view of the nature of the material, he imagined that everything would have to be built on piles, or else some kind of subsidence would take place, such as took place at Tilbury Docks, where the quays and sheds continually settled from the time that they were constructed.

He had been interested to hear that the skin-friction in the monoliths was almost the same as he had found it to be in the case of the first monoliths sunk at Tilbury Dock. They were the first monoliths ever put down in the port, and had been designed by Sir Frederick Palmer, and sunk in the years 1912 to 1917. It had been stated earlier in the discussion that the material at Tilbury differed from that at the Mudfield site, but it seemed that the skin-friction in the two cases was about the same.

Mr. A. T. Best remarked that on page 170 the Author referred to the change made in the layout of the north side of the Victoria Dock, from a jetty or gridiron type to a straight quay. That alteration raised the general question of the life of engineering works. The Author remarked that the stability of the quay wall depended on tie-rods, and that the jetties " were inadequate . . . too frail . . . and too short," and he added: " These facts are not surprising when it is realised that the jetties were built 80 years ago, and that the whole dock is reputed to have cost only £730,000." The engineer of the Victoria Dock Company had been Mr. George Parker Bidder, Past- (then Vice-) President Inst. C.E., and it was one of his greatest works. Mr. Binns had commented on the dock being so close to the City of London, and it was true that transportation had since made it so, but at the time of construction it was regarded as a very venturesome and bold project to build docks right away " in the Essex marshes." However, the dock had been constructed there, and the jetties, which were one of the leading features of the design, came in for nothing but praise; in the discussion on a Paper[1] before The Institution, Mr. Alfred Giles said " the plan of the jetties . . . gave the greatest facilities for the trade that could be well devised." As recently as 1921, Sir Joseph Broodbank wrote*: " The value of the Victoria Dock system of jetties is constantly attested by shipowners who are desirous of quick despatch in emptying their ships and delivering cargo." It was true that even in 1910 Sir Frederick Palmer had declared the dock to be " out of date," and had proposed a straight quay on the north side, but in the discussion on the Paper† referred to, Mr. Abernethy only criticised detail when he said he thought the system of construction adopted for the jetty walls " did not possess that amount of security which was required." The iron tie-rods in a short time " would oxidize, and be apt to fail." Mr. Bidder, in his reply to the discussion, said, " In reply to the observations which had been made, as to the construction of the jetties, that they were not of a permanent character, referring no doubt to the wrought-iron tie-rods, it was desirable to know what was meant by permanence, whether it was thought they ought to last for fifty, a hundred, or five hundred years, as without some stated limit the observations were useless. It could hardly be asserted that, covered up as they were and excluded from the atmosphere, these tie-rods of 2-in. diameter would decay and become useless within the next two hundred years." Not 200, but 80 years had since gone by, and it would be interesting if the Author could say what was the condition in which those tie-rods were found.

Mr. Asa Binns and the **Author** held up one of the tie-rods for the speaker's inspection, showing it to have become tapered to a point at both ends.

Mr. Best said that that raised another factor in the question; the life of engineering works might outlast their usefulness. Mr. Bidder had been a great mathematician, and perhaps he had reckoned it to be better that as an engineering work grew old and out of date in its general form it should simultaneously grow old and decay in construction; and possibly he reckoned that, if, instead of spending another £100,000 on the dock, he saved £100,000, in 80 years, even at 3 per cent., that would become £1,000,000, and would be sufficient to pay for works such as those which had now been carried out.

Mr. D. C. Bean said that his remarks would refer particularly to the quay wall at Mudfield. Some three years ago, he had had the privilege of seeing the extensive reconstruction works carried out by the South Australian Harbours Board at Port Adelaide. The designing engineer had presented a Paper to the Institution of Engineers of Australia‡ in which he discussed the various possible wall types in detail, and stated his reasons for the adoption of the type shown in Fig. 15 of that Paper, as being low initial cost, small maintenance and the adaptability of the design to varying soil conditions along the length of the work. It had occurred to Mr. Bean that that type of design might be equally applicable at Mudfield for the very same reasons. The chief features of the design were the reinforced-concrete superstructure, which was carried on a system of forward and backward raking piles with a curtain of sheeting in front. The stability of the wall was secured by the horizontal forces from the earth-pressure plus the ships' pull, combining with the vertical load of earth on the anchor-slab to produce an inclined resultant, which was transmitted through the anchor-slab to the system of raking piles. It had also the advantage of screening the sheeting from any extra earth-pressure due to excess loading. The wall had all the features desirable in dock construction, particularly as it was very stiff in all directions; the anchor-slab acted as a very strong horizontal beam able to transmit the bump of a ship against it to a number of the pile trestles, and the front wall was stiffened by the counterforts to give again that same distribution on to other piles. Had that type of construction been considered for use at the Mudfield and, if so, why had it not been used? It had been extensively used on the Continent and in America for walls of even greater height than that described by the Author, and the cost had been stated to be only 75 per cent. of that of a monolith type of construction.

(To be continued).

[1] Footnote (†), p. 138.

* " History of the Port of London." p. 194. London, 1921.

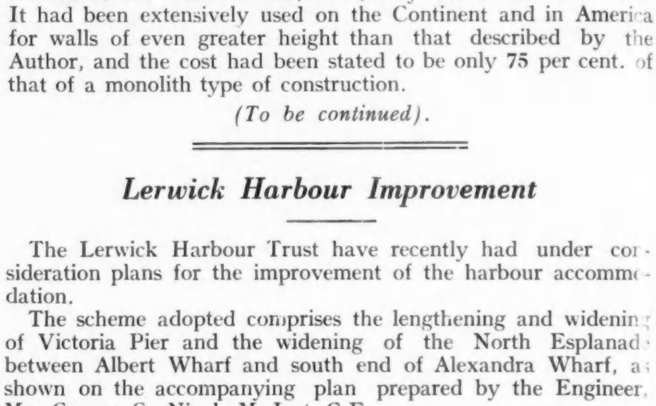
† Footnote (†), p. 138.

‡ F. Andres, " Notes on the Development of Quay Walls." Journal Inst. Eng. Aust., vol. 7 (1935), p. 93.

Lerwick Harbour Improvement

The Lerwick Harbour Trust have recently had under consideration plans for the improvement of the harbour accommodation.

The scheme adopted comprises the lengthening and widening of Victoria Pier and the widening of the North Esplanade between Albert Wharf and south end of Alexandra Wharf, as shown on the accompanying plan prepared by the Engineer, Mr. George G. Nicol, M. Inst. C.E.



Victoria Pier is the main pier of the port; practically all the incoming and outgoing goods of these islands are loaded or discharged at the pier, with the exception of cargoes of cured herrings and imports of coal, salt and fish-curing stock, etc. The present pier is, approximately, 370-ft. long and 56-ft. wide, with a depth of water alongside at L.W.O.S.T., varying from 4-ft. at the inner end to over 20-ft. at the seaward end. About the middle of the pier there is a goods shed, which has a length of 140-ft. and a width of 30-ft.; it is principally used for vessels trading with the mainland, as also for those trading with the islands and for general goods traffic by the traders of Lerwick. It can be seen that there is very little space left for ordinary traffic, and it is on account of the congestion on the pier, and the fact that all vehicular traffic entering or leaving the goods shed must do so by the end door, which causes considerable inconvenience and delay to traders in obtaining delivery of goods, that the Trustees have now decided to improve the existing facilities.

Lerwick Harbour Improvements—continued

The new scheme is to lengthen Victoria Pier by 56-ft., to increase the width of the pier from 56-ft. to 100-ft., on the north side, for a distance of approximately 240-ft., where a fillet is to be provided, approximately 164-ft. in length, to the base of the pier. In addition, the store accommodation will be considerably larger, and better facilities will be provided for traders obtaining prompt delivery of goods by the provision of side doors on the north side of the shed.

The other part of the scheme is the widening of the Esplanade, which carries practically the whole of the County traffic. The roadway is very narrow and congested, and widening at this particular point will remedy the congestion at a bottle-neck, and also do away with the old wooden jetties and provide better berthing accommodation for fishing vessels.

The new works are to be constructed of reinforced concrete at an estimated cost of £35,000 to £36,000.

*Stevedoring**

By W. J. DAVIDSON
Manager of the Port of Liverpool Stevedoring Company, Ltd.

Scope of Modern Stevedoring

Several trades and professions claim to be the oldest in the world; on the very best authority, it can be claimed by Stevedoring. The first recorded Stevedore was Noah. He, as you know, had at his disposal a complete vessel. He was not concerned with a ship's draught, several loading or several discharging ports. Apart from all that, so far as history goes, the cargo took itself on board. There is nothing in history to show that, in fact, it did not adequately and safely stow itself. To-day, the task of his successor is a vastly different matter. One of the Standard Dictionaries gives the following definition of "Art":—"those in which manual labour is chiefly concerned, including all the various trades and manufactures." "Science" is defined as:—"knowledge reduced to a system." That Stevedoring is a combination of both, cannot be denied; the art of stowing goods in a ship's hold can only be learned in the hard school of experience, and that knowledge reduced to a system. Ships which load a complete self-stowing cargo, for discharge subsequently at one port only, are, unfortunately, few and far between. A cargo of case goods, even if shipped in those much-spoken of fibre-board cases, for discharge in *one* port, is merely a dream. What the average stevedore has to contemplate is a vessel, probably loading at five or six different ports for discharge at 5, 10, 15, 20, or more ports. After all, a ship is not an elastic entity; there is only so much enclosed space which cannot be made either more or less. Unfortunately, the shipowner and the shipper of goods make it necessary for our *system* to be so elastic as to render it almost indistinguishable to the inexperienced spectator. For anyone to see a large passenger and cargo liner on the last day of loading with eight or ten gangs (viz., 160/200 men), picking up, trucking, loading and stowing cargo for any or all of 24 ports, is a sight which cannot but stir the imagination of any thinking man. Behind all this bustle and noise there must be organisation, cool and calm deliberation, and the necessary knowledge to ensure *not only* the careful and free from damage transit of the goods, but the stability and safety of the vessel and her passengers. By the uninitiated it is fondly imagined that the loading of a vessel is composed of iron and steel on the bottom, case goods on top of that, and bale goods on top of all. That, of course, is the Utopian idea, which stevedore managers dream of, and, unfortunately, never realise.

Ships have to be loaded in a certain time; on the average, three days is about the limit. In this time 1,000, 2,000, 3,000, 4,000, even 5,000 tons may have to be loaded. Usually, and by the very perversity of things, those goods which are required to be loaded first arrive alongside the vessel last. I often wonder how shippers manage to achieve this extraordinary result. However, notwithstanding the shippers' delinquincies in this direction, in the course of time and after a few hard words, the cargo is loaded eventually, and the ship sails at her allotted time. Up to now, I have referred to the ordinary and every-day type of cargo which, in itself, is interesting enough, seeing that it comprises every known article required by every trade in practically every country. A thousand tons per day of eight hours is the usual amount of tonnage handled and, apart from the fundamental difficulty of getting a quart into a pint jug, a number of other factors enter into the problem. The one which most readily comes to mind is that however many ports of loading, and however many ports of discharge there may be, the cargo must be so arranged that the vessel is, to all intents and purposes, on an even keel, or as we describe it, "in trim."

* Paper read before the Manchester and District Traffic Association on December 15th, 1938.

The average cargo liner, lifting about 8,000 tons dead-weight of cargo, will take about 50/60 tons "per inch immersion." That, of course, only applies to her mean draught of water, if, say 100 tons is placed in her No. 5 hatch or her No. 1 hatch, another factor, called "Change of trim," has to be considered; roughly speaking, the 100 tons will put her down aft 9-ins. and lift her head up about 5-ins., or *vice versa*. You will appreciate that this factor is constantly functioning, and is one of such paramount importance that it must continuously be borne in mind. The loaded draught of a vessel may be as much as 29-ft., and at some very small port 6,000 miles away, and on a certain day coinciding with her anticipated arrival there—there may be only 24-ft. of water on the bar; another factor thus creeps into the problem, and the stevedore has, in consultation with the responsible officials, to ascertain and make the necessary allowances for the coal, oil, water and stores to be consumed "en voyage." The amount of cargo loaded can only be that which, after the consumption of stores, etc., allows her to float at a mean draught of less than 24-ft., and so enable her to enter that port.

One other item which has not to be overlooked during loading is what is known as the "allowance for fresh water." As you know, the density of salt water is greater than that of fresh water and will therefore float a vessel at a less draught. Usually, vessels are loaded in river water, which is "brackish," that is, part salt and part fresh. In this case the rise is calculated, to ensure her making the voyage at her full-load capacity. None of these factors had to be brought into the calculations of Captain Noah, the father of stevedoring. Such is the broad outline of the facts underlying stevedoring.

It is not, of course, a business of continuous hard words—it has amusing interludes. For instance, on one occasion several hundred thousand pounds worth of silver coins were received for export to South America, having been transported by motor vans from London to Liverpool. The vans travelled all night on a special route under police surveillance, and extra police were in attendance on the dock and ship. At 6 a.m. they arrived at their local garage, where the drivers were relieved and changed. The first van arrived in the dock shed with a flourish of trumpets, and backed up to the ship's side for unloading. The driver came round to the back, put his hand in his pocket for the key to unlock the padlock—no key! It had been left on the table in the garage.

The section of Stevedoring, which has always appealed most to me, is that dealing with the handling of heavy lifts, such as locomotives, loco-boilers, railway coaches, launches, tugs, and all the various kinds and types of packages which are too large to be accommodated in a ship's hold. One awkward piece was an 18-ton lift, measuring 215-ft. long. Another consignment to be put on board a 4,500-ton steamer consisted of two complete steel lighters, weighing 250 tons each. The vessel left port with a lighter hanging about 6-ft. over each side of the fore-deck; this was necessitated by their beam. Nevertheless, the stowing and securing was so efficiently done that the lighters were landed quite safely 6,000 miles away. Unwieldy packages, such as those described, are, of course, stowed on deck; but let me assure you there is nothing haphazard in the acceptance of such materials for deck storage. Whilst to the layman, a deck may appear clear and free of obstructions, as a stevedore I say very feelingly, the man who constructed the ships I have in the back of my mind must have collected all the spare ventilators, overflow pipes, sounding pipes, bollards, ring bolts, cleats, etc., and placed them here and there with the diabolical intention of making things difficult for the poor stevedore. When a large package for shipment is offering, the stevedore is consulted, and often with the most meagre information, is required to give an answer to the question: "Can she take it?" On his reply probably depends the employment of scores of men to construct the piece—and lo! another contract is secured for this country.

Some of the gentlemen present are interested in the manufacture or construction of very large pieces of machinery. I would like to point out that very often some small part which forms an excrescence is liable to become damaged, owing to its protrusion from the main piece; this, in effect, means that the whole package is exposed to just that much more risk than a smaller piece.

As one instance of this added risk, we have recently shipped several rail cars, complete in every detail, glass windows and coach finished. On the front of the power-coach two chromium-plated horns projected. There seems to be a good deal of unanimity as to where they might have been placed, and from what I can gather from the men handling the package, it would *not be* on the coach.

A year or so ago, about 200 electric railway coaches were for shipment to South America; of these, 90 were transported by one of the Companies with which I am connected. They were 68-ft. long by 10-ft. 6-in. wide, 12-ft. high, and weighed 55 tons and 35 tons each, the former being the power-coaches. They were carried on deck in 4's, 3's and 2's. With 6-ins. of space to spare on each side, they were *all* safely loaded and dispatched

Stevedoring—continued

from this country, with an average loading time of ten minutes for each coach. The only damage done during the loading of the whole of this contract was a slight rub on the body work of one, caused by the vessel moving slightly during the process.

By the nature of things, it is not always easy to ascertain or be certain that there is sufficient room and clearance to accommodate large or awkward packages. An inquiry was recently received as to the stowage for an aeroplane for one of H.M. Ships stationed at Bermuda, the measurements were 36-ft. 8½-in. by 6-ft. 7½-in. by 9-ft. 0½-in. We were given to understand that stowage had to be below-deck, or it would go by another route. Using a blue print profile plan on a scale of 1/16th of an inch to 1-ft., it was decided to accept, as we considered we had 1-in. to spare. We gave the package the necessary dip, a difficult enough process in all conscience, lowered it down the hold, and found we were shy of 1½-ins.; finally, an alternative stowage on deck had to be arranged, but it took a long time to convince the shipowner and others that it was almost impossible to gauge 3-ins. on a 1/16th plan. Whilst one is always pleased to have the help and practical experience of the technical expert who has been concerned in the construction of these engineering products, I would like to point out the difficulties encountered by the stevedore, who has not available the machine shop lifting gear and appliances in the form of travelling cranes, gantrys and runways. You will appreciate that a ship's hold or deck is anything but a machine shop, and also the labour available is only of a casual nature. Nevertheless, a few minutes' conversation and discussion is always appreciated, and gives one the opportunity of being able to point out any snags or difficulties there may be, in order to ensure safe and satisfactory stowage.

One would imagine that the handling of heavy and bulky packages would be the principal anxiety of a stevedore's life; such is not the case, at least, not in mine. So much for loading ships.

And now as to inward cargoes:—The duties of a stevedore in regard to these are to discharge and deliver cargo from the ship's tackles to the consignee or the master porter appointed to act by the shipowners. You, Gentlemen, will doubtless be acquainted with the terms of your Bills of Lading, which state that the cargo must be taken from the ship's tackles as fast as ship can deliver. The point at which the stevedore gives delivery is situated somewhere between heaven and earth, where a man is able to unhook the sling. Not on the quayside, but inside the shed. Theoretically, the master porter unhooks the sling and the stevedore hooks on the empty sling to send it back.

As you can well imagine, inward cargoes consist of every known commodity under the sun. Of all the thousands of things brought into this country, nearly all require a different method of handling. This demands great flexibility in the gangs working, seeing that one cargo may be composed of sugar in bags, nitrate of soda in bulk and in bags, bran, cotton, pollards, wool, wheat, oats, barley, tin ores, zinc concentrates, copper ores, ingot bars and slabs of copper, dry fruit, fresh fruit in the form of apples, oranges and grape-fruit, fresh lobsters and tinned sardines. A cargo such as this would probably represent from **7/9,000** tons, and when all has been landed satisfactorily and one has a few moments to congratulate oneself on a good job well done, a memo is received to inform you that a claim has been received for the short landing of six tins of sardines, which some person more religious than honest appropriated for his lunch last Friday. Up to a few years ago, nitrate of soda from Chile used to be imported into this country in bags; after the war it was superseded by a synthetic nitrate, manufactured in Germany. Owing to this, many firms were put out of business, and the Chilean Nitrate trade practically died. You will all remember the great fleets of British sailing vessels which once existed in the West Coast trade. Shipowners were approached, and one of the firms with which I am connected, being the pioneers of the liner traffic to and from Chile, were consulted with regard to cheapening the transportation costs. As Stevedore and Master Porter, I was asked as to the practicability of discharging nitrate in bulk. To cut a long story short, I indicated my willingness to co-operate with the firm involved. Now we discharge nitrate in bulk with bucket elevators, straight up out of the hold along belt conveyors and down a chute into a continuous round of motor vehicles discharging from **350** to **450** tons per day per elevator. The German nitrate trade is practically defunct, and the Chilean Natural Nitrate trade has been re-born.

You will remember that earlier on, I referred to experts; they are to be met with in most walks of life, and I have no doubt they fill very useful positions in their respective spheres. One I have in mind came down to inspect some sugar which, on examination, had a grey-blue marking on several hundreds of the bags. We had seen similar spots on shipments for years previously, the consignee's representative having ascertained that this ship carried zinc concentrates which was of a grey-blue colour, made the statement that it was damaged by zinc-concentrate and refused to accept delivery. We tried to advise him not to be silly by reporting on these lines. He insisted, and eventually the Technical Expert arrived to perform his examination. I did say *perform*, didn't I? Perform is right. He scraped a little sugar syrup with the grey-blue shade on to put it into his mouth, smacked his lips to get the full flavour of it, took a halfpenny out of his pocket, and put it between his lips. After a moment, he took it out and said one word, "Zinc." Being only a stevedore, I felt my ignorance would be excused if I asked what he was testing for? His reply was "Galvanic action—zinc and copper." He must have thought that he was a "Le Clanché Battery." Briefly, on his recommendation the sugar was refused and a claim for **£2,000** put in. We sent a sample to the Public Analyst, who reported "No trace of metallic substance of *any* kind either on the bags or in the sugar; the blue cast is a living organism and commonly known as mould." The claim was withdrawn and the sugar collected, and, as far as I know, you and I have eaten it long ago.

Another interesting episode, if I may. A live Jaguar arrived from Ecuador a little while ago. It made itself famous by gnawing its way out of its box one pleasant morning at 1 a.m. A member of the crew saw it, and then lost sight of it in his haste to get into his own quarters. He dashed in, closed the door, and informed his colleagues. Going to the bathroom a few minutes later, he was considerably surprised to see the Jaguar sitting on a table in front of him; he had shut himself and the animal in the crew's quarters. The animal was eventually caught and, in due course, the vessel arrived at Liverpool. It was decided to get an expert from the local Zoo to perform the necessary transfer from its present temporary abode to a cage fit for its transport to destination. His idea was a beefsteak on an iron rod, held in front of its nose, slowly withdrawing it, and (theoretically) the Jaguar would walk after it into the new cage. He must have heard the story of the Donkey and the Carrots; so had the Jaguar.

After two hours of this fooling, one of my dockers said he would get it into the cage. In desperation, he was allowed to exercise his ingenuity. He opened the lid, got a piece of wood and gave that Jaguar a slap on a place which had never before been slapped by a docker or a zoologist. Need I say, the Jaguar bolted into his new cage like a scalded cat. Such is the life of a stevedore. It has variety you must admit.

Large and heavy packages are not usual in inward cargoes, although, at the present time, we are occupied landing and receiving those high-speed reconnaissance planes which have been ordered from the U.S.A. Cargoes in bags and bales are, of course, every-day features, but there are many cargoes carried in bulk, such as mineral ores, oil, grain, nitrate, cotton seed, sunflower seed meal, linseed meat, etc. These, too, have special methods of discharge; for instance, grain is discharged by pneumatic elevators at a speed of **150** tons per hour. It is automatically weighed, and is given a continuous discharge. Ores, seed and meal are discharged in baskets or tubs. It is usual to discharge **1,000** tons of general cargo per day

There is included in the word Stevedoring one feature which you may not associate with our work, that is the coaling and bunkering of ships. When a vessel requires bunkering, it is usual to engage the coal hoist, from which the coal is tipped into the bunker hatch. The stevedore is responsible for seeing the wagons properly tipped and emptied, and for trimming the coal back into the various pockets which are usually around the engine room sides. Great care and attention must be given to the trimming to ensure each space being filled to capacity, and the coal secured against shifting when at sea.

Care has to be exercised that the coal is not broken up too much, for it is the powdered coal which causes that shipmaster's nightmare: "spontaneous combustion," with the resultant fire at sea. If old coal remains on board, it has to be shifted to the bunker doors, ready for first use on sailing day. This ensures a continuous round of new coal and minimises the danger of fire. **800** to **1,000** tons per 8-hour day is the average rate of loading, and the total quantity, about **4,000** tons. It is usual for such large quantities to be supplied from several collieries. Specific quantities of slack and nuts are ordered, which, of course, require mixing before consumption. This mixing is performed by the stevedore, who arranges the tipping of so many wagons of each kind in a given ratio as instructed by the shipowners.

Thus, Gentlemen, the stevedore's day closes not at **5** p.m., when all self-respecting offices do, but at **12** midnight, and his new day commences at one minute past twelve.

Corrigendum

In the review in the April issue of the Advance Project for the Organisation of the Port of Buenos Aires, a correction is needed to a statement made therein which otherwise may be misleading. It is stated that the Thames Conservancy went out of existence with the creation of the Port of London Authority. There should have been added the words "so far as the administration of the Port of London is concerned." The Thames Conservancy is still "in existence," but its functions have been radically altered and are now limited to the control of the river above Teddington. They have nothing to do with the affairs of the port.